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A demonstration of how colors may be specified for use by all those trades and professions involved in building science. This is of vital importance in furthering the use of color, not only in structures but in every other aspect of our daily usage. Free enterprise requires a color language in order to expand the use of color, and to allow for specified tolerances and variations which can be established on a scientific basis. Presented are the results of studies which suggest, not only to the building industry but to all those who use color, a simple, comprehensive method of color identification. Topics discussed include--(1) color identification based on color order, (2) problems of color identification, (3) color identification for the building industry, (4) color in architecture, (5) the problem of color communication, (6) merchandising through color, (7) a plea for color coordination, and (8) color in interior design. (RK)

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Identification of Colors for Building

Publication No. 1001

Report of a program
held as part of the
BRI 1961 Fall Conferences

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Milton C. Coon Jr.
MILTON C. COON, JR.
Executive Vice President

Contents

Page

INTRODUCTION
Milo D. Folley, Sargent-Webster-Crenshaw & Folley, Architects & Engineers 1

COLOR IDENTIFICATION BASED ON COLOR ORDER
Blanche R. Bellamy, Munsell Color Company, Inc. 3

PROBLEMS OF COLOR IDENTIFICATION
Kenneth L. Kelly, National Bureau of Standards 12

COLOR IDENTIFICATION FOR THE BUILDING INDUSTRY
Everett R. Call, Call Marketing Services, Inc. 20

PANEL DISCUSSION

Introduction -- Richard N. Jones, LIFE Magazine; Panel Moderator 28
Color in Architecture -- Waldron Faulkner, Faulkner, Kingsbury & Stenhouse, Architects 29
The Problem of Color Communication -- Henry D. Bixby, Central Commercial Company 32
Merchandising Through Color -- Beatrice West, Beatrice West Color, Inc. 34
A Plea for Color Coordination -- Jerome Miller, Long Island Home Builders Institute, Inc. 39
Color in Interior Design -- Gladys Miller, New Homes Guide and Home Modernizing Guide 40

OPEN FORUM DISCUSSION
Moderator: Richard N. Jones, LIFE Magazine 44

APPENDIX
Expression of Historical Usage -- Interim Report of the ISCC Subcommittee on Problem 23 49

BRI PUBLICATIONS 65

1961-62
BRI PROGRAMS DIVISION II
--BUILDING DESIGN

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Introduction

By Milo D. Folley, Sargent-Webster-Crenshaw & Folley

COLOR IS IMPORTANT to everyone associated with the building industry. Nothing is more effective in gaining acceptance for the products of the building industry than color, and nothing is more personal than color. This variance results in a multitude of individual opinions and preferences which affect the use of color.

Several years ago at a BRI conference, I asked a member of the paint industry why they did not standardize their colors on an industry-wide basis. I received a very cool reply indicating that specially developed colors were the stock in trade of each producer, and no standardization would be acceptable. As an architect, I found this attitude toward such a positive subject to be a deterrent to proper specification, and a hazard to fair bidding practices. I understand why an exotic color name such as French Nude could inspire the purchase of a certain brand of paint, but how can I, as an architect, specify such a proprietary name when only one company lists this color?

As a result of this original interest, I became a member of the Inter-Society Color Council. In this group, I found a serious, dedicated membership studying problems of color. One group in particular was involved in a program concerning the "historical usage of color." They had analyzed the history of various color systems, and had found that the Munsell notations could be used as a common denominator and be considered as a universal color language.

The ISCC is composed of 27 national societies and trade associations, and more than 700 individual members. The aims and purposes of the Council are to stimulate and coordinate the work being done by the various societies, organizations, and associations leading to standardization, description and specification of color, and to promote the practical application of the results to the color problems arising in science.

Standardization of a method of color identification appears to be the reasonable solution to problems of industry coordination of color usage. This does not mean standardization of colors. It

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means only a proposed agreement on which to base our identification of colors.

In the presentation of the following papers, we hope to demonstrate how colors may be specified for use by all those trades and professions involved in building science. This will be of vital importance in furthering the use of color, not only in structures but in every other aspect of our daily usage. We have viewed attempts to standardize on a particular palette of colors, but we feel that this is not compatible with the American concept of competition for the market. If one manufacturer desires to copyright the name of a color, or if he wishes to formulate a particular group of muted paint tones, he is free to do so. He need only identify his colors by an agreed method, and those who must match or contrast them can do so by referring to the specification.

Free enterprise requires a color language in order to expand the use of color, and to allow for specified tolerances and variations which can be established on a scientific basis. We present herewith the results of studies which suggest, not only to the building industry but to all those who use color, a simple, comprehensive method of color identification.

Color Identification Based on Color Order

By Blanche R. Bellamy, Munsell Color Company, Inc.

Abstract: The Munsell method of color identification presented in this paper is a basic part of a standard method now quite widely used, and is also proposed for consideration by the building industry. Accurate color designations for the appearance of all surface-reflecting specimens may be determined through its use. Some applications of the method are described.

THE METHOD OF COLOR NOTATION presented in this paper is a basic part of a standard method of color identification proposed for consideration of the building industry. It is simple in concept. Accurate color designations for the appearance of all surface-reflecting specimens may be determined through its use.

This method was developed at the turn of the century by Professor A. H. Munsell. It is known as the Munsell system of color notation (18). In developing a method for specifying color, Professor Munsell had two ideas in mind. First, a color notation should indicate the color of an object as perceived by the observer. Second, the notation assigned to the color of the object should be based upon an accurately reproducible method of color measurement.

How well he succeeded is evidenced by the fact that his notation is used all over the world in the fields of science, art and industry (1, 2, 3, 4, 5, 7, 8, 13, 14, 18, 22). In fact, his concept has so intrigued the color scientist, that references to papers covering studies and applications of the notation would fill a sizable volume. Suffice it to say that, in addition to numerous individual endeavors, two complete issues of the Journal of the Optical Society of America have been devoted to studies of the Munsell notation and representative samples (9, 10). Physical, psychophysical and psychological data resulting from these studies provide the contemporary standards used for accurate reproduction of the samples.

The American Society for Testing and Materials and the Japanese Standards Association have adopted the notation as a standard method for specifying colors. It is used by soil scientists, horticulturists, and geologists, over the face of the earth, for classifying the colors of soils, plants and rocks. The British Standards

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BELLAMY, BLANCHE R. Manager, Munsell Color Company, Inc.; member, Inter-Society Color Council and Optical Society of America.

Institution has used the notation for designating colors of buildings and decorative paints. The Porcelain Enamel Institute uses the notation for identifying enamels in architecture. Merriam-Webster's Third New International Dictionary, published in 1961, includes the Munsell system in its excellent section on color.

The Munsell method of color notation is based on the concept that the appearance of a color may be analyzed and described in terms of three attributes. These are identified in the Munsell system as Hue, Value and Chroma. These three attributes are arranged in orderly scales of equal visual steps, so that each attribute becomes a dimension or parameter, combining to form a space representation of color (Fig. 1). Under standard conditions of illuminating and viewing, these scales serve as an accurate instrument for color measurement of all surface-reflecting objects.

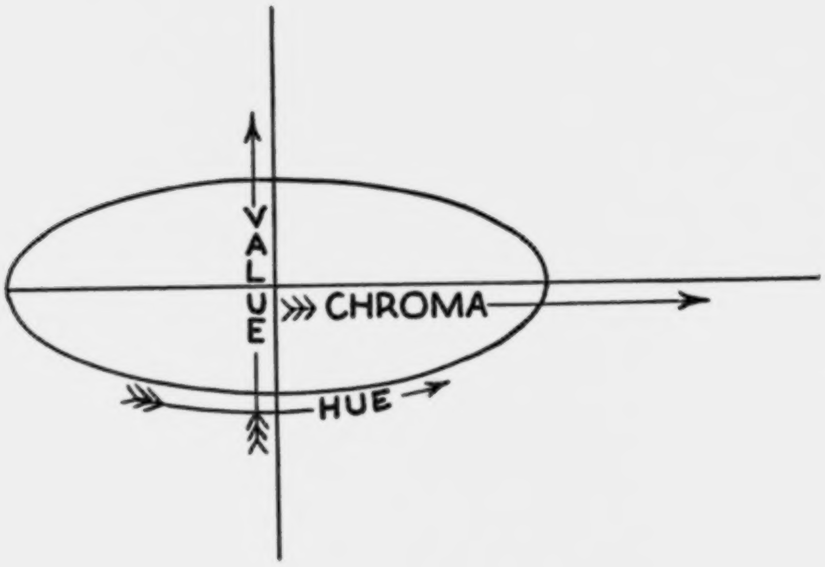

Figure 1. Color space diagram.

Chromatic colors in the Munsell system are divided into five principal classes. These are given the hue names of red, yellow, green, blue, and purple. A further division yields the hue names yellow-red, green-yellow, blue-green, purple-blue, and red-purple. Hence, the hue notation of all chromatic colors indicates the relation to the ten major hues or any of their subdivisions.

Capitalized initials "R" for red, "YR" for yellow-red, etc., are used as symbols for the hue names. When finer subdivisions are required, the ten major hues may be divided into ten steps each (1R to 10R, 1YR to 10YR, etc.), thus increasing the hue notation to increments of one hundred, or more if decimals are used (20; see Fig.2).

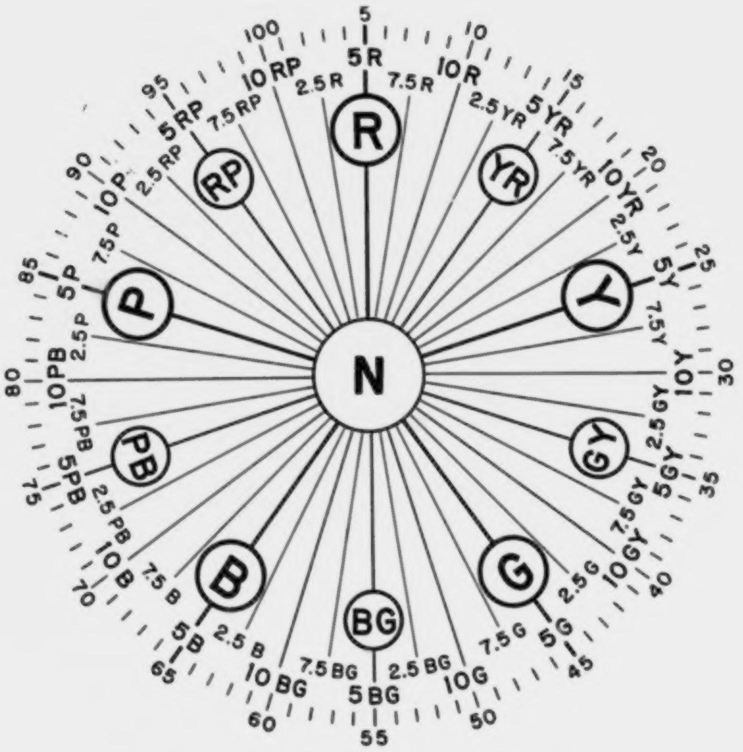
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Figure 2. Hue symbols and their relation to one another. This diagram illustrates the several forms used to record hue notation. When gross approximations only are required, simple initials for the ten major hues are used. When accurate analysis is required, numerals combined with initials, or numerals alone, are employed. For general use, the combination of numerals with initials has been found most convenient.

The value notation indicates the degree of lightness of a color in relation to a neutral gray scale. This scale extends from a theoretically pure black (at 0 light reflectance), symbolized as 0/, to a theoretically pure white (at 100% light reflectance), symbolized as 10/. Neutral and chromatic colors that appear visually half-way between pure black and pure white have a value notation of 5/. Lighter colors are indicated by numbers ranging above 5/, while darker colors are indicated by numbers below 5/.

The chroma notation of a color indicates the strength (saturation) or degree of departure of a particular hue from a neutral of the same value. The scale of chroma extends from /0 for a neutral gray, out to /10, /12, /14, or further, depending upon the strength or saturation of the individual color. A color classified popularly as Royal Blue might have a chroma as strong as /10, while another color of the same hue and value, classified popularly as Slate might have a chroma as weak as /2.

The complete Munsell notation for chromatic colors is written H V/C (5R 4/10) with a solidus separating the value and chroma numerals. For neutral colors the letter N replaces the hue symbol and the chroma numeral is 0, or it may be omitted, thus: N 4/0 or N 4/.

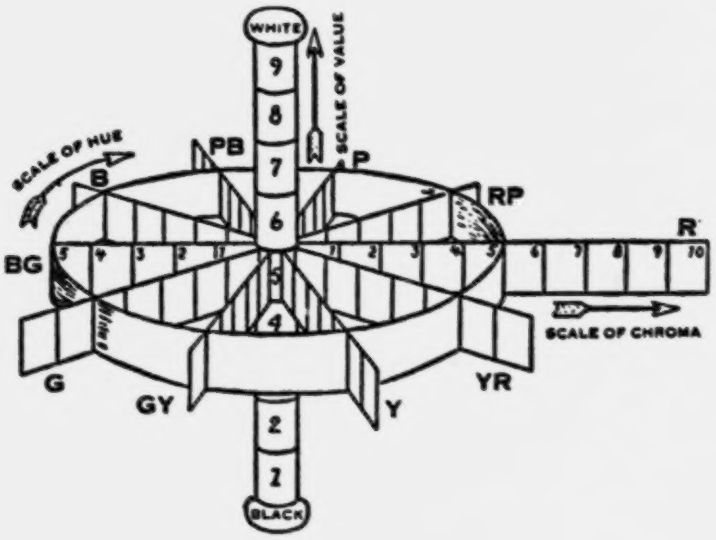

Figure 3.
Scales of hue, value, and chroma in relation to color space.

It is apparent how the scales of hue, value, and chroma (Fig. 3) fit into the color space diagram shown in Figure 1. This space representation of color is frequently referred to as a "color solid," and it includes every color that the eye can distinguish. A model of the Munsell color solid is illustrated in Figure 4. You will note that the shape of the solid is not symmetrical. It conforms to, or is limited by, the chromas obtainable at each value level for each hue. The "key," or most saturated, colors for the various hues differ in chromatic strength. These key colors, also, vary in lightness for the different hues, i.e., they are located at different value levels, depending upon the particular hue.

Vertical, horizontal, or cylindrical slices through the color solid will reveal charts of constant hue, constant value and constant chroma, respectively. Through use of the slicing technique, one can see how a color sample may be described in Munsell terms. If we make a vertical slice through the color solid, we might pull out an array of charted colors in which the neutral value scale appears in a vertical column in the center, with value and chroma scales for the hues 5Y and 5PB arranged on the opposing sides of the scales. The samples on each side of the neutral scale are of constant hue, but they vary in value and chroma. The notation of the sample in question is, by reference to the 5PB constant hue chart, 5PB 5/6 (Fig. 5, page 8).

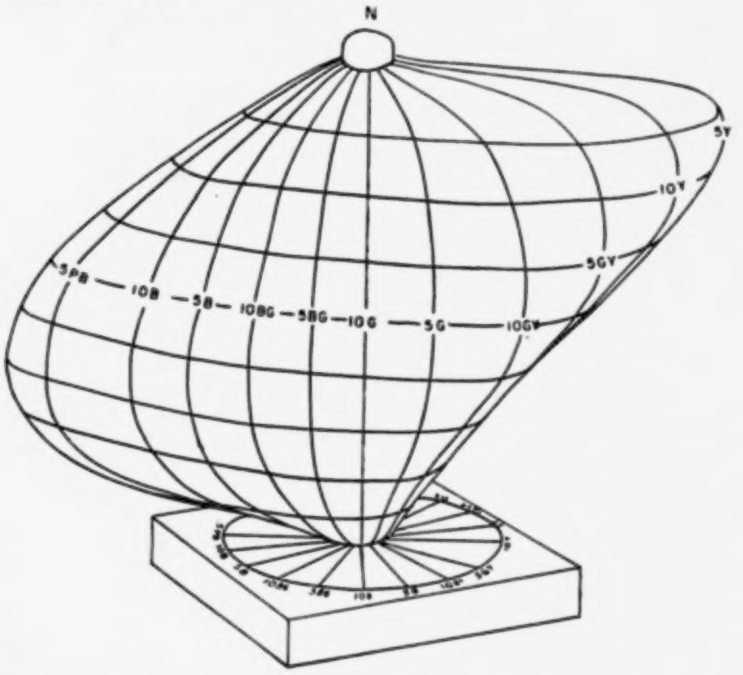

Figure 4. Diagrammatic representation of the Munsell color space in solid form. Maximum chroma samples of each hue and value have their place on the surface of such a model. Theoretically each point inside the surface represents a different color, the colors changing gradually from one to another in each of the three attributes: hue, value, and chroma.

On the 5/ level of the 5PB chart there are also samples which represent the color names of Royal Blue (at chroma /10) and Slate (at chroma /2) referred to previously. However, many of the samples in the area surrounding 5PB 5/2 might be given the popular name Slate, and many of the samples in the area surrounding 5PB 5/10 might be classified as Royal Blue. The Munsell notation provides an accurate designation for a particular sample in a popular color name area.

A horizontal slice through the color solid will reveal samples all of the same lightness, but varying in value and chroma. A slice at the 5/ value level shows the sample in question again to be 5PB 5/6.

A cylindrical slice through the solid will reveal samples all of the same chroma. A slice at chroma /6, again, indicates the

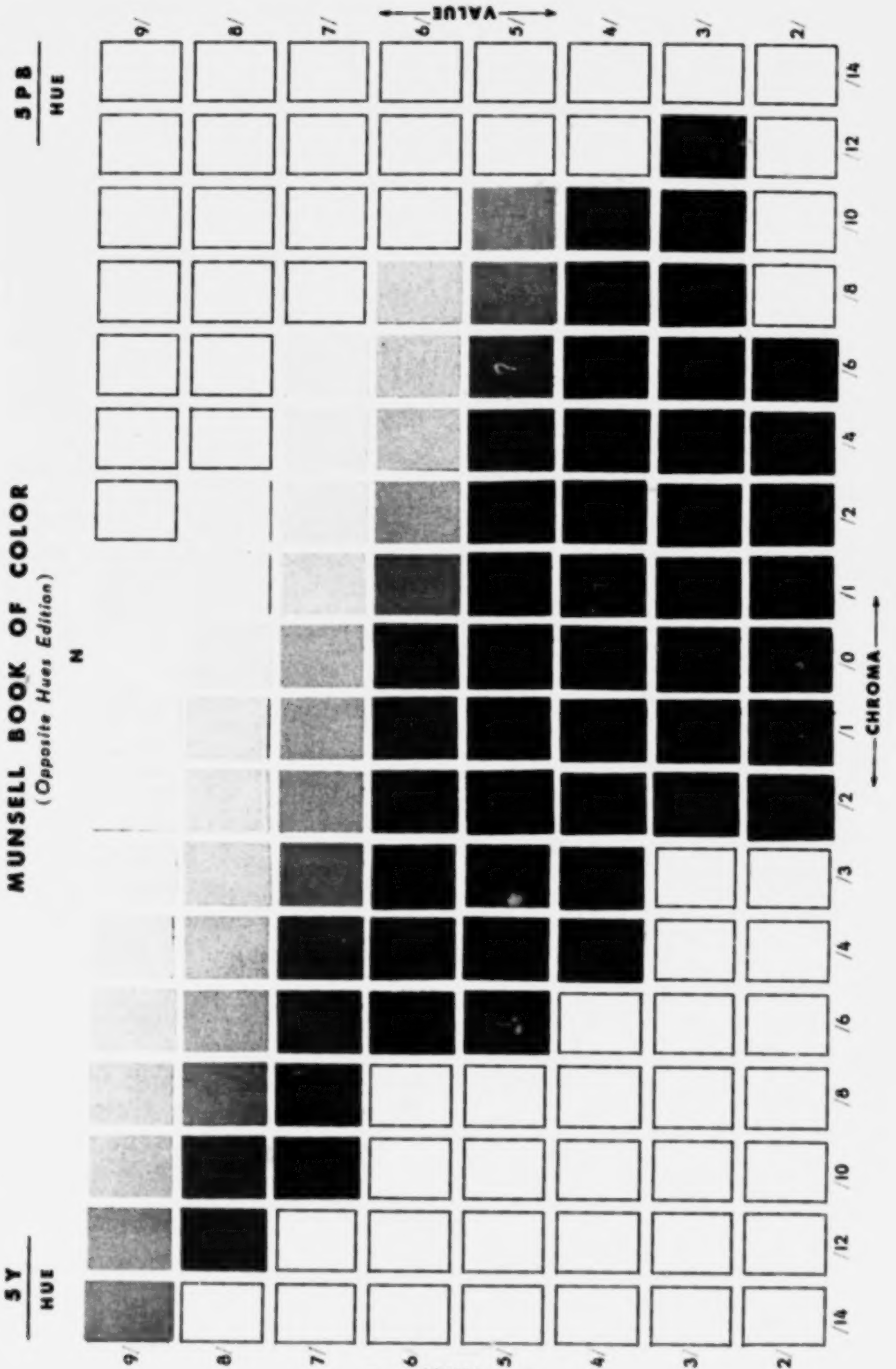

Figure 5. Vertical slice through color solid, showing neutral value scale in center, with value and chroma scales for hues 5Y and 5PB on opposing sides of the scales.

color of the sample to be 5PB 5/6. If a cut in the solid, regardless of direction, passes through the sample in question, we will come out with the same notation of the sample.

The eye can distinguish approximately 10 million differences in color (21). Departures in any direction, no matter how small, from the samples displayed on charts representing the Munsell system, constitute another position in the color solid and therefore a different Munsell notation. A collection of charts showing variations in value and chroma for at least 40 hues is required to identify the notations of samples with this potential for variety (16).

Samples reflecting colors falling between those displayed on the charts may be identified by interpolation between the notations of the charted samples. Thus, a sample falling visually half-way between the hues 5PB and 7.5PB (a neighboring hue to 5PB in the 40-hue series) has a hue notation of 6.25PB. If it is half-way in lightness between value 5/ and value 6/, it has a value notation of 5.5/. If it is a quarter way in chroma between /6 and /8, it has a chroma notation of /6.5. Thus, through the use of the decimal system, a Munsell notation for any surface-reflecting sample may be obtained. Conversely, a Munsell notation for which no physical sample exists may be specified.

A collection of charts displaying samples exposed by equally spaced slices through the color solid, whether vertical, horizontal, cylindrical, or otherwise, provides a serviceable tool for identifying all colors (6).

A system of color notation, based on samples of equal visual spacing, provides an excellent method for recording color tolerances (12). Color tolerance sets afford visual aids in judging the acceptability of a color match, and are quite popular in the industrial and advertising fields (16).

The results of formulations for colorant mixture may be recorded in Munsell terms. Thus, color standards for future formulations may be established. It is seldom that results from colorant mixture formulas obtain the exact color required. A knowledge of color order is of considerable value in determining the direction and proportion of alteration necessary to obtain the desired color.

A knowledge of color order and a notation based on that order serve also, in the development and specification of pleasing and, if required, startling color designs.

There are other methods of describing color. There are other tools (or instruments) for measuring color, but for accurate specification of the appearance of color, the Munsell is most direct. Through the use of the notation, color samples from any collection, or color specifications from instrumental measurement, may be converted to a common language. The papers following will discuss how these methods, color samples, and results from instrumental measurement may be related to color space and Munsell notation to provide a standard procedure for solution of many problems of color identification in the building industry.

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Problems of Color Identification

By Kenneth L. Kelly, National Bureau of Standards

Abstract: The ISCC-NBS method of designating colors is a systematic arrangement of color names, to which are assigned corresponding colors. The psychological color solid is divided into 267 blocks, each illustrated by a color representing its center, or centroid. Boundaries of the blocks are described in terms of well-known color-order systems. Thus, the ISCC-NBS system supplies a means of describing colors in simple terms, of converting from one color-order system to another, of determining synonyms and near synonyms among the color names, and coordinating different degrees of fineness of color description and designation.

COLOR CAN BE DESCRIBED by the use of three dimensions, but what really is color? Color may be defined as a qualitative component of visual experience characterized by the attributes of hue, lightness, and saturation, but in certain cases having zero saturation and consequently no hue, i.e., a neutral such as a gray. The light reflected from or transmitted through objects which gives rise to this sensation, the portion of the whole electromagnetic spectrum that you see, and that we call the visual spectrum, is only a very small part in the middle. Toward longer wave lengths, we find the infrared or heat waves, then radar, television, and radio waves. Toward shorter wave lengths, we find the ultraviolet waves that sunburn, then X-rays, gamma, and finally cosmic rays.

Briefly, there are three ways in which a color may be identified, or described: by the use of words, by comparison with the colored samples of a color-order system, or by the numerical results of a color measurement. Each of these has its uses. This paper will discuss them, and how they relate to each other.

Ever since the language of man began to develop, words or expressions have been used first to indicate and then to describe colors. As the language developed, more and more color names were invented to describe the colors used in art and industry and, in late years, in the rapidly expanding field of sales promotion. Many fanciful color names came into vogue, such as French Nude or Pearly Gates. Other color names were confusing, for how could you know that African Green was in reality a blue, or that Blue

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KELLY, KENNETH L. Physicist (optics), Photometry and Colorimetry Section, National Bureau of Standards; member, American Association for the Advancement of Science, Optical Society of America, Inter-Society Color Council.

Fox was a reddish gray? Different color vocabularies were developed for use in different fields of color description.

As the designation of colors became more and more detailed, a number of color-order systems were developed, and it became customary to assign color names to the individual samples in these systems. It was only natural that the same color name would not be applied to exactly the same color in each of the color-order systems, and so these color names really came to describe ranges of color. This was fine for sales promotion, but was very confusing if one was trying to describe the color of a certain object, such as a brick. There have been a number of color-order systems published through the years. I am going to mention only the few which you may meet in your work, listing some of their advantages and disadvantages.

The Munsell Book of Color (2, 6, 11, 14, 18, 19, 20, 21, 23, 27) contains about 1,000 colored samples, either mat or glossy, arranged according to the Munsell scales of hue, value and chroma. Each sample on any one chart is intended to have the same hue; each sample in a row on any chart is intended to have the same lightness (Munsell term-value); and any sample in a particular column is intended to have the same saturation (Munsell term-chroma). This is a true color-appearance system, in that the hue steps between successive charts have been selected to appear even, as have the successive steps in the value scale, and those in the chroma scale. Each sample is identified by three symbols, the first indicating Munsell hue, the second Munsell value, and the third Munsell chroma.

This Munsell notation, because it is based on uniformly spaced scales of color, is amenable to interpolation and extrapolation among the samples, and is useful in the solution of many problems in industry. Used as a method of color appearance specification, this notation is quite as important as the colored samples. It can be, and in fact is, used by many who do not own a book of samples, since it can be used to describe the appearance of colors on other charts. The colored samples representing this system have been measured spectrophotometrically by a number of investigators and are identified by Munsell notation, rather than by color names. However, popular color names can be assigned to them, if required, through the medium of the ISCC-NBS Dictionary of Color Names, which will be discussed later.

The Dictionary of Color by Maerz and Paul (16) is a monumental work, and has been used extensively in the description and specification of color. It contains 56 plates illustrating 7,056 semi-glossy colored samples formed through the use of mixtures of eight chromatic and seven base gray pigments, accomplished through the half-tone printing process. Due to the large number of samples, they are so close together in color that interpolation is usually unnecessary. The coverage of the halftone screen plates has been so adjusted that the color steps between successive samples are in general about equal. Each color is identified by the number of the chart, a letter to indicate the column, and a number to indicate the row. A dictionary of about 4,000 color names keyed to the colored samples is included, along with much information on the early history and development of the color names. Munsell notations of the first 2,592 samples in the red to yellow colors were published by Nickerson (22) in 1947.

The Color Harmony Manual published by the Container Corporation of America (3, 4, 5, 10) is based on the color theory of Ostwald. It consists of 30 triangular charts, contains 943 colored samples, and is much used in the study of color harmony and color coordination in design. The samples are divided into charts of constant dominant wavelength and into scales of constant black content, constant white content, and constant full color. Each sample takes the form of a 7/8 inch hexagon made by applying a mat-finish pigmented film to a clear, transparent sheet of cellulose acetate, one side of the sample thus being mat and the other glossy. These samples have been measured on the spectrophotometer and the Munsell notation determined for both sides of the chips. A Descriptive Color Names Dictionary (28) keyed to these colored chips contains the color names used to describe the color of general merchandise for the mass markets.

The Plochere Color System (24) was developed as an aid to decorators and interior painters, and for use in the selection of color harmonies. This system is divided into 26 hues based on the Ostwald system and contains 1,248 mat colored samples. To each of these is assigned a letter designation indicating the color, a letter and number designation indicating the composition of the paint used, a serial number, and a color name. The Munsell notations of these colors were published by Middleton (17) in 1949.

Color Standards and Color Nomenclature (26) by Robert Ridgway was developed for the description by naturalists of the colors of rocks, soils, plants, flowers, insects and birds. This system has been out of print for some years, but is included because it is so well known and is still used by some who are fortunate enough to have one of the books. It contains 1,115 mat colored samples and to each is assigned a color name. These color names are listed alphabetically in the front of the book along with a key indicating the color so named. Munsell notations for these colors were published by Hamly (7, 8) in 1949.

There have been a number of other color-order systems developed through the years (mostly for specialized purposes), some with restricted color gamuts, some with color names and some without, and one used in dermatology that has Latin color names.

From these short descriptions, you will see that most of the color names used in these systems are those in use, keyed to the approximate colors. That is, the color names follow the system of the colored samples; they do not form a system themselves. There has long been a need for a color-name system in which the names follow definite orders and are illustrated by colored samples.

The color names used to describe the colors of drugs and medicines in the United States Pharmacopoeia (29) and the National Formulary (1) were not based on any system and yet had to serve as standards of purity. In the ninth revision of the USP there were a blackish white, several brownish greens, and brownish purples, among other confusing color names. At the request of the Chairman of Revision of the USP, the National Bureau of Standards in co-operation with the Inter-Society Color Council (ISCC-NBS) developed a system of color names that was accurate enough to satisfy the scientist, usable enough for the industrialist, and simple enough to be understood by the average man on the street.

The ISCC-NBS system is contained in a set of color-name charts whose coordinates are given in terms of the Munsell scales of hue, value, and chroma. The psychological color solid was divided into 267 blocks, each containing about the same range in color, and to each block was assigned in a regular order a simple color name consisting of a hue name and one or more modifiers, such as very dark red, light greenish yellow, or vivid purple (Fig. 1). Each chart shows a set of color-name blocks with their associated color names, and is a constant hue-name chart.

To use the charts, given the Munsell notation of a color and required to find the corresponding ISCC-NBS color name, one plots the Munsell notation of the color on the color-name charts according to the scales of hue, value, and chroma. The color name of the block in which the notation plots is the name used to designate the color. If the plotted point falls on a boundary between two or more blocks, the color should be assigned both or all the color names of the contiguous blocks, or an appropriate selection of one or more color names may be made (15).

The words dictionary of color names appear in the title. This came about through the desire to express the boundaries of the color-name blocks in terms of other color-order systems, such as those mentioned above. It was not possible to do this until the colored samples, in the Color Harmony Manual for instance, had been measured and Munsell notations assigned. Plotting this notation indicated which ISCC-NBS block and color name corresponded to each of the colors in this color-order system. This was done for the 13 color-order systems for which Munsell notations had been assigned to their colored samples, and the color names from each of them were assembled alphabetically to form the color-names dictionary. With each of these color names there is given a code letter indicating the proper color-order system, the ISCC-NBS color name, and the number of the corresponding color-name block. There are approximately 17,400 entries in the dictionary.

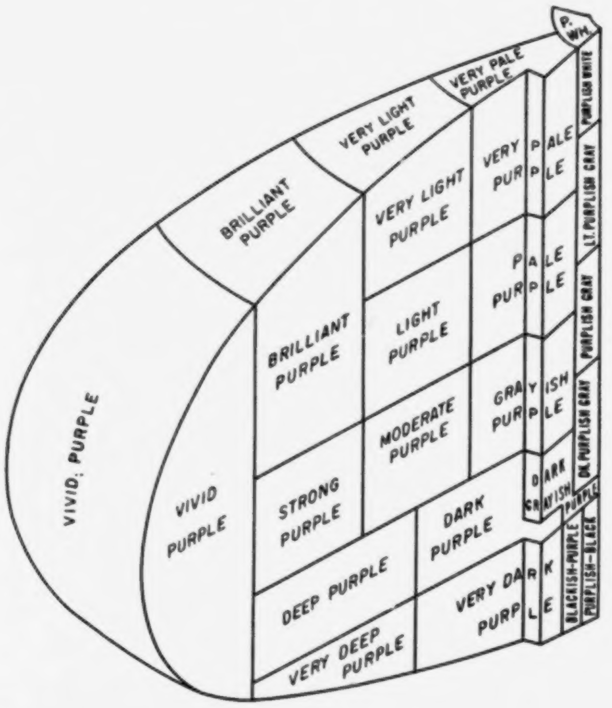
P. WH.
VERY PALE PURPLE
VERY LIGHT PURPLE
BRILLIANT PURPLE
VIVID: PURPLE
VERY LIGHT PURPLE
VERY P ALE
PUR P LE
P A LE
PUR P LE
BRILLIANT PURPLE
LIGHT PURPLE
GRA Y ISH
PUR P LE
MODERATE PURPLE
VIVID PURPLE
STRONG PURPLE
D ARK
GR AYISH
PURPLE
DARK PURPLE
DEEP PURPLE
VERY DA R K
PURP L E
VERY DEEP PURPLE
PURPLISH WHITE
LT. PURPLISH GRAY
PURPLISH GRAY
DK. PURPLISH GRAY
BLACKISH-PURPLE
PURPLISH-BLACK

Figure 1. Sector of the psychological color solid showing all the ISCC-NBS color-name blocks for the hue name, purple.

Next, all of the color names in these color-order systems, whose corresponding Munsell notations plotted within one ISCC-NBS color-name group or block are therefore nearly synonymous. All of these color names are arranged according to this plan in the middle section of the color-names dictionary. Also, with each of these color names there is given the notation in the appropriate color-order system of the colored sample descriptive of that color name. Thus, if one wanted to find a color name in Plochere nearly synonymous to one in Maerz and Paul, it could be done through this table. Likewise, if one wanted to find a near-match of a color in the Color Harmony Manual to a color in the Federal Color Card, NBS Circular 553 would again be used.

Now let us go one step further in precision. Suppose that a color had been measured on a spectrophotometer or a colorimeter and the numerical designation determined. Through the use of the proper set of charts or a highspeed computer (12, 25) this numerical designation can be transformed into the corresponding Munsell notation. Through this notation, the corresponding ISCC-NBS color name can be found. So you see that it is possible to determine the ISCC-NBS color name from a Munsell notation, or the notation in any one of the other 13 color-order systems listed, or from the numerical results of an instrumental measurement. The ISCC-NBS Color Names Dictionary, therefore, acts as a means of translation with the Munsell notation as a common denominator.

The Color-Names Dictionary does not contain any sample colors. It has long been the hope of the Inter-Society Color Council and the National Bureau of Standards that someday, somehow, color charts could be added to illustrate the color-name charts. But which colors? It was finally decided that the most descriptive color of a color-name block would be its central color, or one illustrating the center of gravity or centroid of the block, because some of them are of odd shape, and these 267 centroids were determined and published (13).

At this time, the ISCC Subcommittee for Problem 23, Expression of Historical Color Usage (color trends), needed a method of color designation and decided that the ISCC-NBS centroid colors would be a logical starting point. This project was considered sufficiently important by the ISCC that it reactivated its Subcommittee for Problem 2, Color Names, to oversee the production of these centroid colors with the author as chairman. Again the ISCC and the National Bureau of Standards teamed up. It was agreed that the ISCC would finance the project and the Bureau of Standards would undertake the measurements and studies necessary to insure that the prototype centroid colors would match the published centroid notations within stated tolerances. In this way, proper centroids would be produced which could be used in the solution of Subcommittee 23's problem (9) and at the same time they would be available to illustrate a set of constant hue-name charts which would be published as a supplement to the Color Names Dictionary.

The prototype centroid colors were produced by a color company in Pennsylvania, and the mass-produced centroid colors, based on the D and H samples, are being produced by a color company in St. Louis. These chart sets will be sold through the Standard Samples Program of the National Bureau of Standards and eventually will be bound with a future reprinting of the Color Names Dictionary.

These ISCC-NBS centroid colors are few in number (220 to 230 are possible with modern pigments), yet they sample the psychological color solid throughout its entire extent. Now, for the first time, a uniform system of simple, accurate, understandable color names has been produced, and most of these color names are illustrated with their own corresponding centroid colors. The great advantage of the ISCC-NBS method of designating colors lies in its ability to offer a coordinated plan of different degrees of fineness of color description and designation. The illustration of the color-name blocks with their centroid colors completes the final step of this plan.

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*See pages 49 to 63 of the present report.

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Color Identification for the Building Industry

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Abstract: A system for reporting usage of consumer products by color, which would provide a means of color designation usable by all industries as well as a common color language, is discussed. A color service in which manufacturers and producers can participate by reporting their sales in terms of individual colors is then described. A loose-leaf manual presenting the scope of colors available in a particular product, with colors keyed to Munsell notations, is suggested as a means of providing a common color language.

ONE REASON COLOR IDENTIFICATION has become so complicated is that everyone is free to utilize color as he sees fit. There are actually very few rules, and even where rules can be applied, it seems each user develops his own. One basis for this seemingly freehand approach is that the use of color differs with each product. In some instances, it is the material that is the determining factor; in others it is the surface, the end-use of the product, or the manufacturing process itself, that results in a specific manufacturer or industry adopting a different approach to color.

While I have been, and am, interested in the myriad technical problems in the field of color, as a representative of an economic and marketing research company, my major concern is the marketing aspects of color. The preceding papers have given excellent scientific descriptions of color, but in my field, color is more often briefly described as "the consumer's dream and the manufacturer's nightmare." I believe you will agree that while color is without doubt one of the best sales tools available, the ultimate value of color in marketing is rarely realized.

Leaving out of our consideration the fact that every manufacturer suffers from various production and control problems, it might seem that all you have to do is to reach out and take the color you happen to touch and use it -- certainly nearly every shade of the spectrum is in use on some product. But, as many of you are painfully aware, the use of color is not quite that simple. As you start to devote serious thought to the problem, you become aware of such things as the physiological effect of color, color

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blindness, blending of color, and the effect of lighting on the appearance of color, along with many other problems.

Let us assume that you have met all of these problems and solved them. There are three other categories of problems that still beset you, and sooner or later the nightmares occur. These three problems are: first, the economics involved in producing and stocking a color line; second, the problem of evaluating the consumer's desires insofar as color is concerned; and third, the problem of understanding the various languages employed when discussing or describing color.

The problem of economics differs for each product and, indeed, for each producer. In the past, the problem of evaluating the consumer's desires has been a difficult one, and has been solved by each manufacturer and for each product, individually, if at all. This has necessitated costly and time-consuming surveys resulting in data on a limited number of products, representing a small part of the economy. Each such survey is limited to the colors in a particular line of merchandise, or to the colors in the surveyor's palette. Thus, unless one surveyor conducts all the surveys, it is difficult to correlate the results in any but the crudest details.

Adding to the confusion might seem impossible, but it isn't. Assuming that a color choice has been made, the architect, builder, color consultant, or interior designer finds it necessary to communicate this choice of a color to manufacturers of various building materials, as well as to others. The problem arises when one is confronted with color names such as Waterfall (one word), which is a green, and Water Fall (two words), which is a blue -- or exactly what colors are meant by such terms as Salmon Pink, Desert Gray, Rose Gray, Sunrise, Rose Nude or Promised Land?

The subject of this paper is a unique approach to determining consumer acceptance of various colors, while at the same time providing a solution to the communications problem. It is an approach that offers many bonuses to the user.

A few years ago, as the Director of Marketing Research and Statistics for the National Paint, Varnish and Lacquer Association, one of my tasks was to conduct an annual survey of the colors of ready-mixed paints sold. In analyzing the results, I realized that this survey was of very little value to our members because, while they knew what their competition was doing, there were no data available indicating color usage by other industries whose products would affect the consumer's ultimate choice of colors of ready-mixed paint. Further, even if such data were available, they could not be compared with surveys of the paint industry, because of the many color designation systems used.

In a speech before the Annual Meeting of the Inter-Society Color Council (ISCC), I suggested that they establish a problem subcommittee to develop a method of expressing historical color usage data, that is, color trends. The Council agreed and, as my reward for offering this suggestion, I was named co-chairman of the committee which became known as ISCC Subcommittee for Problem 23 -- Expression of Historical Color Usage. The objective of the Subcommittee was "to develop a technique of expressing historical color usage of consumer products in order to facilitate intercomparisons among industries." Or, as the ISCC later described it, our objective was "to derive compatible methods for recording historical consumer color preferences for products in individual industries, to publicize these methods and encourage all industries to adopt them so that (1) useful historical records of consumer preference trends of their products may be available within individual industries and (2) the interrelationship of consumer color preferences of one product upon the choice of another product may be established among industries."

When the ISCC named the committee to work on this problem, the membership of the committee read like a page from the "Who's Who in Color." In our case, not only did each committee member give freely and considerably of his time and effort but many other Council members contributed their special talents. Before the subcommittee could proceed with its assigned task, a color designation system was needed that would be acceptable to all industries, one that would correlate data expressed with different degrees of precision and in different color-order systems, as well as one that would allow for easy handling of huge masses of statistical data.

We soon learned that none of the available systems would be acceptable to all industries. However, we did have available the Inter-Society Color Council-National Bureau of Standards (ISCC-NBS) color-names system, wherein the boundaries of the 267 named blocks were specified in terms of the Munsell system and therefore, by extension, in terms of a number of the recognized identification systems such as Maerz and Paul, Plochere, or Ostwald (also known as the Color Harmony Manual), as well as others. Next, we were faced with providing color identification for industries that were not concerned with precise color designation, either because of usage or because the tolerances resulting from manufacturing processes were so broad. Again, the ISCC-NBS color names system was the key.

While we were struggling with designation problems, we were at the same time working to develop a statistical method. With direction provided by Kenneth Kelly of the National Bureau of Standards, and through the application of the ISCC-NBS system, we developed a simple method of dividing the color solid into successively smaller blocks in five steps. Each finer subdivision is accomplished by dividing the blocks in the previous step. Thus in step A, the entire color solid is divided into 13 large blocks. In step B, some of these 13 blocks are divided into a total of 29 blocks. These 29 blocks are further divided into 267 smaller blocks -- the ISCC-NBS method. These 267 ISCC-NBS blocks are specified in terms of the Munsell system, which contains 1,000 to 1,200 colored samples. These colored Munsell samples have been measured and specified in terms of the numerical CIE coordinates, x, y, and Y. As Mrs. Bellamy explained earlier, by use of decimals the Munsell designation system is limitless. Thus, this system provides five levels of precision of specification of a color; the color specification blocks in any level are connected to the blocks in another level by a predetermined plan; and it provides practically an endless number of designations. Hence, at all times, the complete color solid is included. This method is described fully in the report of the ISCC Subcommittee for Problem 23 which is reprinted in the present report as an appendix (see pages 49 to 63).

As I mentioned earlier, manufacturers of various products view color differently. For example, the paint manufacturer can and does deal with color in terms of Munsell notations, or sometimes even in terms of CIE coordinates that Mr. Kelly discussed in his paper. However, in cases where the manufacturing process will not permit such accuracy, or when a color match is not required, the ISCC-NBS blocks serve all specification and designation, as well as identification, requirements. So, regardless of how color is treated by the individual manufacturer, each can utilize at least one level of Subcommittee 23's method for classification and reporting purposes. The levels that include only 29 and 13 colors are useful in permitting easy statistical treatment and simple charting of color usage.

Architect Milo D. Folley, who is a member of ISCC Subcommittee 17--Color in the Building Industry, outlined at a recent meeting of the ISCC the color problems facing architects, designers, and builders, and asked if Subcommittee 23's method be utilized by the entire building and building materials industry. Our answer was a biased "yes," on several counts.

Mr. Folley described the major problem of architects with the field of color as the lack of a universal, systematic designation--the lack of a common color language. This lack, he said, has placed the architect at a disadvantage in any plans to achieve color coordination when a variety of materials is being used. You will recall that one of the aims successfully achieved by the Subcommittee for Problem 23 was to find a system of color designation that would work for all industries, regardless of how a particular industry handles its color specifications. Hence, we now have an instrument that provides a common color language.

I hasten to add that our approach does not require the abolition of custom names, nor does it require a manufacturer to restrict his palette of colors in any sense. Rather, our approach makes it possible for a manufacturer to take maximum advantage of this marketing tool in a manner that allows those concerned to specify colors appropriately.

The next question was, would all industries adopt this method? As most manufacturers well know, there are many reasons why the color system now in use was adopted or developed. They at present go to considerable lengths to assist the architect in making his color choices. However, I am sure we are all aware of his problem, and the handicap under which he now labors. Further, I feel certain that manufacturers would further assist the architect, builder, color consultant or interior designer, if at the same time, they could increase their sales, increase profit rates, reduce inventory losses due to color obsolescence, reduce cost of color development, and increase the efficiency of purchasing programs.

The key to all these advantages is in use of the method of expressing historical color usage information as developed by the ISCC. However, it must be taken one step further by providing a means of processing data from all industries, so each manufacturer can compare his experiences directly with his industry total, or with other industries. By doing this, color trends can be developed permitting participating companies to have a color already in their lines, when the consumer first seeks that specific color in that particular product. Also, these same trends will indicate when a color will drop in popularity, permitting a manufacturer to take a color out of his line, or to reduce production to a point compatible with demand. Let us take as an example an appliance manufacturer. His choice of colors is determined by those for which the consumer has already shown a preference in his purchases of cabinets, tile, floor coverings, and counter tops. The appliance must fit into the decor of the room as it now exists. Every product in the home is affected by the color choice of another, be it telephones, paints, rugs, draperies, towels, tissues, tiles, siding, shower curtains, bedspreads, or -- you name it.

There is an organization equipped to develop and analyze color trends in a service available to all manufacturers and retailers. In order to participate, a company need only report its color experience in terms of percentage of total sales represented by each color used, in accordance with the methods developed by the ISCC. These data are converted into Munsell notations and fed into a computer. Using a specially designed computer program, the data are processed and are available in practically any conceivable form. For example, a paint manufacturer can obtain a complete picture of the relative importance of the colors (expressed in terms of Munsell notations) used in tile, floor coverings, stoves, refrigerators, tables, counter tops, kitchen cabinets, bathroom fixtures, draperies, rugs or any other product.

Why would a paint manufacturer want this information, or why would the others want the paint color data? Because these data show what colors the consumer has accepted. Certainly, the choice of the color of a wall paint in the kitchen must be compatible with the longer-lived and more expensive items already in the kitchen.

These special reports show data on a product basis. No individual company's data are ever disclosed. So, in a sense, this is a cooperative venture for the participating companies, as each must contribute before he can take out information. For his cooperation, each receives a composite report at no cost. Special reports by product or by color, compiled to specifications established by those requesting the report, are available for a fee to participating companies only. There are already manufacturers participating in this service representing practically every consumer product, as well as the largest retail organizations. I only mention this to establish the fact that all manufacturers and retailers now participating in this program are using the method developed by the ISCC, and therefore are using a common color language.

If I have suggested to you that all you have to do in order to solve your color choice problems is to participate in a color service, permit me to shatter any such illusion. There is no single answer -- no magic wand that you can simply pass over the problem and automatically find a solution. In the first place, each organization has goals, prohibitions and problems peculiar to itself. Hence, its situation must be considered separately.

There are many tools available to manufacturers by which they can formulate color programs. Each must choose his tools in view of his problems. There is no set pattern. One producer may find that consumer acceptance surveys are necessary; others might find that they can permit a designer to let his artistic abilities run wild. For most, however, the economics of each industry demand a close check on the number of colors utilized. This automatically poses color choice problems.

Again, depending on the product, you should consult the experts, i.e., the colorists and color consultants. They are trained in the complex field of color, and can anticipate problems and provide solutions before an economic disaster calls your attention to these problems. The colorist utilizes every tool he can find, all the way from historical color usage data provided through the color service I mentioned, to the psychological and physiological aspects of color discussed in the preceding papers. In other words, I am suggesting that you utilize the colorist as a color executive, to bring all aspects of color into proper focus. Some companies can afford to have such individuals on staff. These are extremely fortunate but are, unhappily, in the minority.

A color program for building products and materials manufacturers and builders must be developed to fit the specific product and operation. Because of this, I will not attempt to offer an outline of a color program for the building industry. This conference covers the entire field, and each individual must select the elements of most importance to his field of activity. The color problems facing architects are far different from those facing manufacturers, as architects are concerned mainly with the application of color in a specific situation, and coordinating colors for one specific building or group of buildings.

Architects, industrial and interior designers, and even chemists, physicists and illuminating engineers must be consulted on some problems. If we accomplish nothing more than to demonstrate that color is a fantastically complicated field, but that answers are available, then this conference will have been a resounding success. There is no single source of knowledge; however, I believe the starting place is the colorist or color consultant. The truly competent colorists will assure you that they themselves cannot answer all your questions, but they can recognize them, evaluate them, develop an approach, locate the tools, and apply those tools. By tools I refer both to physicists, chemists, illuminating engineers, marketing researchers, designers, and architects, and the statistical tools such as the color service described earlier.

Since we first talked with the architect about the desirability of a common language, we have gone a long, long way toward the point where all industry will adopt a universal color language. While it is true that industry is not adopting this idea for the sole purpose of helping the architect, builder, colorist and designer, this common language is precisely the goal sought by the architect, colorist and designer. It is a fact that a common language is in existence, and that for many reasons it is being adopted by manufacturers and retailers. Further, this same approach can be utilized as an extremely valuable sales tool for manufacturers, as well as an excellent tool for architects, builders, colorists and designers in their efforts to specify colors accurately.

One possible technique for utilization of this concept could be a loose-leaf color manual with a section for each product. Heading each section would be a chart showing the scope of colors available in that product. By scope, I am referring to the highest values and chromas offered. These limits can be determined by the reports of companies participating in the color service mentioned earlier. Also, the tolerances which the builder, architect, color consultant and interior designer must allow because of technical problems involved in the manufacturing process would be shown.

Following each product introduction would appear the colors offered by each manufacturer. Each manufacturer's colors would appear on a separate page or pages, and be identified as that particular company's colors. Under each color chip the manufacturer's own designation would appear along with the Munsell notation. Those who specify colors could use this manual by referring to the Munsell notation of one product, and using this common language in all other color choices.

The development of such a manual would be a tremendous task. Manufacturers currently participating in the color service described above have expressed unanimous interest in such a manual.

If the interest spreads, I personally will do all I can to develop the manual approach. I know I can speak for all those participating in this conference, and for the Inter-Society Color Council when I say that they too will cooperate in every possible way with a responsible group or organization which will undertake this project. While it is a complicated task, the groundwork has been accomplished and the procedure fairly well developed.

Panel Discussion

Moderator:	Richard N. Jones
Panel Members:	Waldron Faulkner, Henry D. Bixby, Beatrice West, Jerome Miller, and Gladys Miller

Introduction

By Richard N. Jones, Panel Moderator

AS A LAYMAN, I am very much impressed with this complex world of color. Participating in this conference are many professionals, many people well-versed in the wonderful world of color, but I suspect, also, there are some people representing manufacturers, or other types of professionals, who are not yet sufficiently versed in the subject to understand when the panel talks about hue and value and chroma.

I have had the good fortune of working with architects, designers, and interior decorators for some 30-odd years, and some of their know-how has rubbed off on me, but I am frank to say on this subject of color I must plead ignorance.

The topic of this panel discussion is an identification system for color. The problem before the house is to create a language. Now, unfortunately, this particular subject does not enable us to get into the area that, sooner or later, we must get into -- the area of standardization. How can we put to use the knowhow that may come out of this discussion? Having spent extensive time at a recent discussion on prefinishing of building components, I am aware of the tremendous problem those of you who are dealing with color must face four years from now.

I say four years, because that is when the building boom should come. When the war-babies explosion takes place, we must be ready. And, we must be ready to prefinish the components with which we will build, which means we must have a common color language. So, when I say we must start now to get this language, this is the first step. No one on this panel is unmindful of the problems that architects and builders have in their minds. Unfortunately, time will not permit us to go as far as we would like.

JONES, RICHARD N. Marketing Specialist, LIFE Magazine; former Advertising Manager, Architectural Forum, and Advertising Sales Director, House & Home Magazine.

We have seen what color has done in the revolution that is taking place in non-residential building. We have seen the great contribution that color has made in commercial and industrial buildings, because architects, builders, and suppliers arrived at a language that worked. They could not afford not to, because they were dealing in millions and millions of dollars worth of expensive nonresidential construction.

Now, as residential building moves over into the area of industrialization, we must be certain that we have the right language to arrive at the right colors for the building components. This is particularly important because yesterday people used to build houses, but people don't build houses any more; they buy them. It was all right to make one color mistake on one house, but with prefabricators already producing 10% of all houses, with 100,000 houses coming off the conveyor line per year, we cannot make the same mistake a hundred thousand times and survive. This is why the question of education and the arrival at a language that is understandable are vitally important to this great industry.

Color in Architecture

By Waldron Faulkner, Faulkner, Kingsbury & Stenhouse

AS AN ARCHITECT in private practice, I am deeply interested in the appearance of building materials. I have spent several years in the study of color in architecture, and realize that color in architecture depends for its life-blood on color in the building industry.

I agree with the basic theme of this conference; that the need for a common language of color identification in the building industry is of paramount importance. I also believe that, until some common method of communication about color is in general use, we shall not be able to solve some of the other pressing color problems with which the architect is concerned. The subject of color identification has already been so ably presented that I wish to take this opportunity to discuss some of the other problems which color identification would help to solve.

One of the architect's most demanding tasks is developing color schemes, and translating them into building materials whose colors will harmonize in the finished building. Architects must make their selections from catalogues, color cards, or samples, but catalogues are soon out of date. Color cards are often inaccurate in their reproductions. Samples accumulate so fast that, unless they are culled frequently, the architect's

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FAULKNER, WALDRON. Senior Partner, Faulkner, Kingsbury & Stenhouse, Architects; Fellow, American Institute of Architects; former president of Inter-Society Color Council.

office soon looks like an exhibit of second-hand building materials.

I often ask myself -- How can the colors of building products be better organized and more usefully presented to architects, designers, builders and owners? There is no easy answer because color problems vary greatly with different products. Many manufactured materials have a wide range of colors which can be controlled quite accurately. The colors of products such as paint have been carefully measured, and can be designated by some accepted method to almost any degree of precision, as outlined in the preceding papers.

On the other hand, natural products such as stone or wood have a relatively narrow gamut that can be controlled only by careful selection. Some, like limestone, have only recently been accurately measured, and even their producers do not know the exact colors of their own products. This being the case, how can the architect, or anybody else, specify their colors?

I would like to offer some specific suggestions as to how the present situation could be improved. First, it seems obvious that, in accord with the theme of this meeting, the entire color range of any product must be measured and specified more or less accurately, depending on the product and the use to be made of it. Unless this is done, its colors cannot be identified with any degree of accuracy.

Second, after the complete gamut of colors has been measured, it seems to me that we should go further and select certain representative colors as standards, to be used as a basis for comparison or identification.

Third, after certain representative colors have been adopted as standards, color tolerances should be set up to show how close colors must be to the standards to be acceptable. Because all colors have three attributes, hue, lightness and saturation, their tolerances must include all of these variables. The method of specification described in the foregoing papers provides a way to do this.

I know that some producers get the cold shivers whenever color tolerances are mentioned above a whisper. I can see no reason for this, if the tolerances are properly set and are mutually agreed upon by architects, color consultants and manufacturers. Rather than leave this situation in its present state of vagueness, it would seem wiser to face the problem frankly, and to have a clear understanding as to what tolerances are reasonable for the manufacturer to meet. Without tolerances there is always the possibility of disagreement as to how far a given color can depart from an approved sample. Tolerances set with proper regard for the producer as well as the customer would be a protection to all concerned.

Fourth, there is the question of color control. I don't know how many architects have said to me -- "Why aren't the colors of building materials more consistently uniform?" I know that natural products and ceramic materials that must be fired are bound to have considerable variation in color, and some of this is often desirable. But I see no reason why materials like floor coverings, that are given the same color name or number by the manufacturer, should not match reasonably well. For instance, last summer I was doing over my kitchen floor and decided to use a gray linoleum tile. About half of this floor had been laid when the next batch arrived. This was a gray tile of another color! Even the man who was laying it complained that it did not match what he had just laid. We had to wait for a day or two for another lot to be sent from Baltimore. In view of the modern techniques of color control, I see no reason why this should happen.

All this emphasizes the need not only for common methods of color identification, but also for better color standards in the building industry. For years color standards have been in common use in many other industries. I refer not only to company standards, but to industry-wide color standards, such as have been adopted by the Porcelain Enamel Institute.

Before this was done, each manufacturer of porcelain enamel was offering different sets of colors, which he hoped his competitors could not match easily. This situation became so acute that it was proposed at the PEI meeting in 1957 that their Architectural Division develop a group of so-called standard architectural colors. This suggestion met with enthusiastic response. Eventually, with the support of the American Institute of Architects, industry-wide standards were adopted. These consisted of 47 colors which could be produced by any qualified manufacturer of porcelain enamel.

They are shown in the PEI Color Guide for Architectural Porcelain Enamel (AIA File No. 15-M-1). Chips of the 47 colors are reproduced by a color-depositing process, which shows even stippled samples accurately. Each has a PEI designation and a Munsell notation. To my mind this is an excellent example of color identification and standardization. Because they are industry-wide standards, it is now possible for architects to select porcelain enamel colors and to specify them in such a way that more than one producer can bid on them.

I know that some producers are leery of industry-wide standards for fear that these would limit them and give their competitors an advantage. My answer to this is that, if a manufacturer does produce colors that conform to an industry-wide standard, he can also produce nonstandard or special colors in addition, should he wish to do so. But, by conforming to the industry-wide standard, he can match the color of any other competitor who does the same thing. In this way, if an architect specifies a color which is an industry-wide standard, any manufacturer who follows this standard can bid.

In closing, let me make a plea for a common method of color identification in the building industry, not only to establish a means of communication in this field, but also as a first step toward solving some of the other color problems that beset architects, customers and producers alike.

The Problem of Color Communication

By Henry D. Bixby, Central Commercial Company

THE CONFERENCE PAPERS have described various color-order systems, their applications, and some of their advantages and disadvantages. Mr. Kelly touched briefly on the purely physical composition of color and the designation of a given color by numerical values. These values are called chromaticity coordinates, and they often cause confusion, especially among the uninitiated. In talking about color, more often than not we encounter communication confusion, due to the complexity of the subject matter. This confusion really exists, and we hope that the method of color specification and techniques of application which have been brought to your attention will decrease chromaticity coordinate confusion in complex color communications -- or you can't tell the colors without a scorecard!

It has been pointed out that architects have at their command a tremendous number of building materials, available in a wide variety of color. The architect, in the expression of his creative abilities, seeks color, texture and form to express his ideas, but color communications between the architect and the manufacturer are at best only a verbal compromise without a color scorecard.

The color designer or stylist faces much the same problem and, in some instances, considerable color confusion occurs when the stylist is employed to color-style a new product line, or to modify or extend an existing line. Only when the color designer and manufacturer have their scorecards can satisfactory color communications take place.

Those involved in advertising and promotion encounter still another facet of the color communication problem, for they must build product identification in the consumer's mind. Imagine Madison Avenue preparing copy for the high-fashion magazines in terms of Color Harmony Manual or Munsell notations -- "Yummy 7 pa sweaters" or "Shocking 5.0 R4.2 12.0 nail polish!" By the same token, no manufacturer in his right mind would relinquish to a set of numbers and letters the well-known and recognized proprietary trade name of his product-color. I certainly would not subscribe to such unimaginative color descriptions.

BIXBY, HENRY D. Chief Ceramic Research Engineer, Central Commercial Company; member, American Ceramic Society, National Institute of Ceramic Engineers, Inter-Society Color Council.

However, those of us in manufacturing must face realistically the problem of obtaining relatively precise knowledge of just what color is wanted in order that we can provide for, rather than dictate, man's use of color. We are also faced with the control of color in processing and the determination of commercially acceptable color variations or tolerances.

As a ceramic engineer, specifically interested in structural clay products, one of the major problems I face is to determine just what color is desired, and the degree of precision required in the color match. The NBS-ISCC centroid system of color specification, and the modifications suggested today, offer a workable method of color communication which will materially assist in solving this problem.

Samples, submitted to me for matching, have included paint chips, cloth swatches, various sizes and textures of colored paper, Color Harmony Manual chips, small pieces of porcelain enamel, glazed tile chips, etc. Verbal descriptions of colors to be matched have included " . . . a dark blue with a reddish cast," " . . . a light pinkish orange, like X brand lipstick," and " . . . a dark gray with brown spots like match heads."

It is interesting (and comforting) to note that the ceramic industry has no monopoly on this problem. At one of the recent Inter-Society Color Council meetings, a speaker from one of the major plastics producers described his experiences in matching the color of a shark's tooth!

Due to breakdowns in color communication between the architect, the color designer, the dealer or salesman, and the manufacturer regarding the desired color and the degree of precision of color match, dissatisfaction has occurred all along the line. As color communication is a two-way street, the manufacturer is also faced with the problem of describing the colors of the products he makes to architects, color designers, and consumers. There appear to be as many different methods of doing this as there are manufacturers.

The size, weight, or shape of a building product is very often the basis for choice of the method of presentation. In addition, the consumer often requires a particular type of sample prior to his purchase. As a result, most manufacturers spend a considerable portion of their advertising budget in preparation and distribution of samples. With the technical progress of the past decade in color photography and the graphic arts, faithful reproductions, from the color standpoint, are now economically available and widely used to present products without the bulk and volume of actual samples.

Miniaturization is no longer the exclusive field of the electronic and communications industries, as more manufacturers have turned to this technique to show the actual material, scaled down to fit into brochures, kits, etc. Here colors and surface textures can be truly representative, but the ultimate use of the product requires an extrapolation from the miniature sample to the end-use that only a few can successfully perform.

The NBS-ISCC centroid color specification system can be easily included in the preparation of samples as described above, and the system described today embodies suitable nomenclature, choice of precision, and ease of use without excessive cost, technical background and training, or the loss of product identification. This is the scorecard which will enable us all to have color communications without confusion.

Merchandising Through Color

By Beatrice West, Beatrice West Color, Inc.

OF ALL VISUAL PHENOMENA, color is so common a part of our daily lives that few of us are ever really conscious of it, or wonder exactly what is color?

To the manufacturer, architect, builder, color consultant, the scientist, designer and consumer, color is one thing; to the artist another; to the psychologist evaluating his experiments, it is something else again. Yet, each concept is dependent on the other and no attempt at a true explanation of a color creation can be made without considering color in all its aspects, and necessarily returning to the question, exactly what is color?

Webster has defined color as: "A quality of visible phenomena, distinct from form and from light and shade, such as the red of blood. . . ." Color is perceived by the eye alone, and is associated with the effect of particular light vibrations on the optic nerve. Although color is one of the shortest words in the dictionary, it is extremely complex, due to the fact that it involves physics, chemistry, physiology and psychology. But the psychological aspect of color is the most important factor we deal with in our everyday lives, for we are constantly dealing with the impact of color upon people, and ultimately, with the way color affects sales.

Because light is perceived differently, no two people will see eye-to-eye on color. However, the professional color consultant is more capable of evaluating color and its varying factors than the untrained eye. Professional color styling is functional color, or a method of color application in which definite objectives are set forth, and in which results are measured. More important,

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WEST, BEATRICE. President, Beatrice West Color, Inc.; member, American Institute of Interior Designers, Architectural League of New York, BRI, Color Association of the U. S., the Inter-Society Color Council, National Home Fashions League, National Association of Home Builders; associate, New York Chapter, American Institute of Architects.

professional color consultants base their recommendations upon research data, rather than personal opinion.

I admit there are many self-appointed color "experts" who specify colors in various fields, who do not use any color system, or a scientific method or approach. Many manufacturers' products have been color styled by an executive's secretary or, more than likely, by his wife.

Color has experienced a real revolution since World War II. At the beginning of the '50's, people were afraid of color, but today color is everywhere. People have accepted color and its powers of persuasion. There is no doubt about it, color is a tremendous merchandising tool, but has the novelty worn off this marketing tool?

First let us review a few of the successes achieved by the trained experts:

1. Automobiles

   Everyone knows the success of color in the automotive industry, but many of the early tycoons balked at the use of color -- even Henry Ford who believed that any color was all right as long as it was black. Today, color is playing an important merchandising role for this industry, more than ever before. From one automotive manufacturer, approximately 650 standard color combinations are available, plus numerous custom color schemes. Color names range from: "Glacier Blue" and "Tropic Mist" to "Nassau Green," all basically the same color. For the consumer, this tremendous choice of color variation and color names can result in "color confusion."

2. Housing Projects

   Several years ago the editors of Fortune Magazine went into a huddle and, after elaborate and careful calculations, produced the statement that since 1947, there were 49 million suburbanites in the United States, which had resulted in the "Suburban Sprawl." For one community of 20,000 houses, color helped to bring individuality to each house and to the entire community, in spite of a single plan for all houses. In color planning, the problem was to use a minimum of colors in a maximum of combinations, by using only 2 roof colors, 4 siding colors, and 8 paint colors, which resulted in no two houses being exactly alike in the total of 144. Professional color styling was well received by the consumer, and proof of the "color pudding" is that the original colors remain the same even today.

   In contrast with this do-it-yourself color styling, professional color styling is functional color, or a method of color application in which definite objectives are set forth and in which results are measured. The self-styled expert does not deal with color systems, scientific data or research methods. Therefore, the results are not always good. Some houses look like banana splits, complete with the cherry on top.

3. Prefabrication

Prefabrication has made tremendous strides in promoting good taste in color, good design, good materials and good public relations. One large prefabricator's sales[1] increased by 27% after the first year's use of color styling services. This alone points up the tremendous part color identification plays in mass production. Shell house manufacturers can profit by the precedent set by prefabricators. They have a golden opportunity to meet this super boom we are expected to have for the next five years by promoting good taste in color and design.

4. Kitchens

The kitchen is one of the most important rooms in the house, where proper color coordination plays a tremendous role. Here is proof that color cliches can be broken, for the all-white kitchen no longer exists. Progressive manufacturers know they can't afford to make mistakes in color. Some prefer to term their year-by-year changes as "planned obsolescence." This is demonstrated by the results of sales figures for one appliance manufacturer[2] who recently announced an all-time high, up 36% over the comparable period in 1960, which was due in part to its color coordination services offered to builders and consumers.

5. Home Furnishings

As Frank Lloyd Wright said: "It is quite impossible to consider the building one thing and its furnishings another . . . floor coverings and hangings are as much a part of the house as the plaster on the walls."[3] It stands to reason that, once the colors are right for the structure, all home furnishings should be coordinated and related by a common code, or color language. More and more big chain stores are realizing the necessity for a color identification system which will provide the store buyers with a means of communication and the manufacturer with a color system for correlating his products with other manufacturers' products used in the home together. This is what it takes -- total communications -- to reach our potential consumer.

6. Telephones

Since the color debut of the telephone five years ago, more than 10 million colored telephones have been installed, even though black phones are installed without additional cost.

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[1] Price, James, of National Homes Corporation. Personal communication, October 1953.

[2] Klein, Julius, of Caloric Corporation. Personal communication, October 1961.

[3] An Autobiography (lst ed.), published by Duell, Sloan & Pearce, 1943.

7. Nonresidential Building

The architect and color designer have brought about tremendous changes in banks and other commercial and industrial buildings, and have departed radically from traditional color specifications. We see the same bright picture when we look at the part that color has played in changing the images of schools, where color plays an important role in reflecting light and in creating the right atmosphere.

In all buildings, the architect, color designer, and building supplier must have a mutual means of communication, a common language for specifying colors in order to avoid "color confusion." In supermarkets, color communication is used to influence the shopper toward impulse buying, and for creating an "image" for the store and its suppliers.

Color therapy plays a tremendous role in hospitals, where the psychological aspect of color is put to use for convalescents to speed recovery; where color is used to direct traffic or otherwise create an atmosphere which is healthful and cheerful. In hotels, color often runs rampant. With the "color revolution" came good and bad examples, and sometimes the results were a vulgar display of the wealth of our age. By contrast, an impression of quiet elegance, dignity, and the prosperity of the present time can be reflected by the use of good taste in colors and materials. Unfortunately, too small a percentage of buildings have been designed by architects, and only a few building manufacturers have moved forward to realize that progress is built on change, and the colors are never static. Others stay with "old hat" methods of production and color, which can make the vital difference between profit and loss in the field of building economics. Contemporary architects, like Eero Saarinen, also stressed the importance of manipulating color to express space.

8. Advertising

In all forms of business communication, in advertisements, promotion, and point-of-purchase material, the switch from black and white to color has produced immeasurable and concrete sales results. In short, color has been accepted by all industries, and whether you are ready for it or not, one basic fact remains -- color is here to stay!

At this point, as a professional color consultant, I am happy to report on the tangible success of color as an important communicator, and as a tremendous merchandising tool. However, the heyday of color as an isolated element in merchandising is fast coming to an end. I do not mean that the sales impact of color is waning. Quite the opposite: the public's acceptance of color was only the beginning. Public taste is more sophisticated and more educated than it was a decade ago. Mere novelty of color is not going to be the primary motivational factor in buying. Today, mass communication approaches a more scientific level, and we are depending increasingly on accurate measuring devices for symbols, language, and trends in color.

But, in attempting to put color on a measurable basis, we run into difficulties not encountered to the same degree by language and by formulas. Where we fall short is in the lack of a universal identification system, a common language, easily understood by all, but based on scientific research. And this is where such people as the members of the Building Research Institute can help. The members of the building industry must work together to create a better understanding and relationship among its professional groups: the architects, engineers, designers, color specialists, manufacturers, builders and other scientists. The marketing "tools" which we have today can bring about a better understanding and more exact knowledge of what color is, with the color systems of Munsell, Ostwald, and others.

The findings of associations and organizations such as the Producers' Council, the Color Association of the United States, the American Institute of Interior Designers Resources Council, the National Paint, Varnish and Lacquer Association, the Inter-Society Color Council, the National Bureau of Standards, and others, are all excellent means of bringing a common denominator to color, of aiding the color specialist with his interpretation of color design, color trends, color preferences, and color specifications.

But even this is not enough to make color a real success in its entirety. Mutual respect and full cooperation among fellow professionals and other members of the construction and building industry is an ingredient absolutely necessary for success. The point is that, today as never before, there is a definite relationship between color and design. Whether a color ends up in high fashion, or in mass production of building materials, depends not so much on the color as on its combination with other colors, and the application of color as it appears on different materials.

This is the basis of our meeting today, to offer our cooperation in bringing about a means of color identification, established by authoritative sources, for aiding the development of color research in the building industry. Let us accept the challenge of society's needs by developing our specialities to their utmost, but primarily by recognizing our own limitations and working together. Only in collaborative effort can we possibly build an environment suited to the best possible use, for our country and for human welfare.

A Plea for Color Coordination

By Jerome Miller, Long Island Home Builders Institute, Inc.

I AM ALSO SOMEWHAT of a novice in color among the many experts here, but perhaps, as Nicholas Murray Butler so aptly put it, "An expert is one who knows more and more about less and less." I, as a builder, have always felt somewhat frustrated by the lack of coordination between manufacturers in the various colors of their products. I was most pleased to be invited here more or less to stress the importance of your work to the builder. This conference offers a system of color communication between manufacturer, industrial designer, architect and color consultant, to coordinate the colors of paint and wall paper, fabric, counter tops, furniture, floor coverings, etc., that go into the dwellings we build.

However, this learned group must now seek to correlate this knowledge with a familiarity with the products that we use, such as wood, concrete, steel, aluminum, brick, plastics, porcelain, and their various textures, light reflection, etc. You have seen in the color chart displayed here, how different colors change as light reflects from them. We have many types of plastics coming into use in building now, and we must know the effect that light is going to have on their colors.

The plastic House of Tomorrow in Disneyland opens great avenues for color. A need for and the desire for fresh, coordinated, sparkling color are going to be rampant. You can see that in many of the new plastics now appearing on the market.

Another new form of dwelling which was recently described in our newspapers, is a plasticized paper house which can allegedly be produced for as little as $1,000. This shows remarkable strength and very many livable qualities, and I foresee in the years to come, if our archaic building codes can be changed, that this paper house may become widely used for summer houses and dwellings in warm climates. The paper house could also be a wonderful vehicle for the use of color. But, there again, we would have to coordinate color all the way down the line.

The color identification and coordination system presented at this conference can be a great help to the builder and his associates in providing a better home for tomorrow. Prefabricated walls are being developed and are gaining wide acceptance in the residential building field. The prefabricated porcelain enameled wall, the glass wall, the wood wall, all are being used for houses, as well as commercial and industrial buildings. No longer need our factories be a drab, uninteresting blight on the landscape. As we

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MILLER, JEROME. President, Long Island Home Builders Institute, Inc.; member, National Association of Home Builders.

see them today, many are somewhat like modern paintings, with their very interesting splotches of color.

There has been a tremendous upsurge in the use of color in building products and materials, but I appeal to those who are manufacturing the products used in our buildings to adhere to the vibrant, basic colors and skip the outlandish ones. Recently I visited one of my friends and saw the current vogue of purple used for bathroom tile. I could foresee that, within a possible two, three, or five years, a plumbing repair might have to be made and this purple tile would be broken. Then, as many times occurs, these people will seek to replace the tile and it will no longer be in inventory.

I've had many customers come to me requesting information as to the purchase of certain colors of asbestos shingles or roof shingles, or various shades of ceramic tile and floor tile, and I find that within the elapsed period these former colors have changed in texture and mottling, so it is very difficult to tell people where to go to replace these vital items. This can, of course, be a very great annoyance and quite costly. Imagine having to retile an entire bathroom because three or four of the tiles are broken. So, again, we need to protect our customers against the fading of colors, or planned obsolescence.

We must strive to provide better protection for our colors, to see that they do not break, chip, crack or craze in handling and shipping. Then, too, communication must be improved between our personnel -- installers and service men -- in order to see that they do not spoil the wonderful colors that the manufacturers provide. All these things can help us to assure better quality, better service, and better homes for the future.

Color in Interior Design

By Gladys Miller, New Homes Guide and Home Modernizing Guide

By occupation I am an editor; by profession I am an interior designer. The American Institute of Interior Designers defines an interior designer as one who, through training and/or experience, can plan, design, and execute an interior and work with the various trades and craftsmen therein involved. We have for about 15 years tried to establish licensing for interior designers, the way the architects are licensed, and we haven't given up, but we are up

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MILLER, GLADYS. Editor, New Homes Guide and Home Modernizing Guide; honorary Doctorate of Fine Arts, Moore Institute of Art, Science & Industry; member, American Institute of Interior Designers, Illuminating Engineering Society, Inter-Society Color Council; National Home Fashions League, The Fashion Group, Decorators Club.

against a hard lobby in every state of the Union. In one state $80,000 was spent to lobby in the state capitol to keep us from being licensed. In the meantime we have gone to the schools to help perfect their curriculums and we now have about 50 colleges, universities, and art schools throughout the country offering a four-year course in interior design.

To be a member of the American Institute of Interior Designers, one must have four years of academic education and four years of apprenticeship with some industry or interior designer in the field, or ten years of practical experience. The professional interior designer regards color and its use as his personal property. If or when he takes the time or trouble to learn the complex and fascinating facts and theories held about colors, he is apt to feel that nosy strangers are intruding into his special domain. But today, this interior designer is learning to be articulate about the way he uses color, and the way he can communicate his use of color to the other people.

There is one area in which I would like to be non-conformist: today we have two markets in color, a class market and a mass market. The class market is always going to be here, I am sure, because we are always going to have wealthy people, some with taste and some without, who are going to demand what the mass market doesn't have. We also find that interior designers are no longer working only on residences. Today we are doing all types of buildings, as well as planes, hospitals, and a great many other things, mainly because we cannot afford to do the individual low-cost house.

Today the interior designer is accepting and formulating a professional vocabulary that must be universally accepted if his profession is to be understood and recognized by the related arts and sciences. The need for methods of communication in the arts is not new. It has taken years for the musical profession to develop its own terminology. Musicians more clearly define modern music than we define modern furnishings or decorative or architectural style. Have musicians matured to face facts? Do we duck? The ballet world is in the process of creating symbols which record the choreography of the dances for all time. When slow motion photography failed, the dancers turned to a code known as the Labanotation system. Rudolf Laban spent 50 years studying the dance and body movements. He was the first to score the dances. His studies are now used as visual aids for those interested in old and new dancing forms. His system is used to record all new dances.

The interior designer can use the sketch, rendering, elevation, and perspective drawings, as well as the camera, to record interior design in its stages of development. But these will never be complete without a language which can explain how, why, what and where each move was made to make the final results satisfactory.

Colors, to the decorating world, are those colorants found in the materials of decoration, paint, wall covering, floor covering, upholstery, and decorative accessories, as well as the stones and building materials which the architect or builder has used.

To be successful, the interior designer must know how to combine many colors in the materials of decoration in a way that is satisfactory to himself and to his client, and incorporate them into his design. What is more, he must know how to distribute these colors in the given areas of interior space to create a comfortable environment. He must know how to balance the lights and darks, the strong and the weak, the neutral and vibrant colors selected. These colors must be attractive at all hours of the day under natural as well as artificial light. They need not match, but they must be harmonious.

Rarely does the interior designer use only one color. If he does, he uses several values and several textures. His interest is to combine several colors in various textures and forms within a given area or space to create a mood or an atmosphere. Whether these colors are pleasing depends on his knowledge and his experience. Seldom does he have the time or desire to be scientific in his approach. Rarely has he had the opportunity of working in the experimental laboratory although, without realizing it, he often employs the experimental process in the trial-and-error method.

Eleanor La Maire, a very famous designer, said: "If I had a motto it would be, 'let there be color'." The secret of using color is knowing how to put two colors together. I used to go to the Chinese theatre in San Francisco, and the costumes were simply gorgeous. They would use red and pink smack up against each other, as we would never think of doing, but here is the catch -- the Chinese put a tiny thread of white between the two colors which the eye would just skip over. They know that white edits color.

William Baldwin, an excellent New York interior designer, has described how he works in doing an interior.

> "A restrained background of floor, wall, ceiling, and curtains can substitute for, or enormously help, the awkward architectural proportions created by a low ceiling. I think very definitely we must have the walls and curtains the same color. It would be a grave error to have the long wall split by a length of contrasting colors in the curtains. As the ceiling is only 8' 6'' high, division by color would emphasize the lack of height. To give the further illusion of height in a room the ceiling and beams should be painted a slightly lighter shade than the walls. I am not considering specific colors but only what, for the sake of the atmosphere and portion, should be light and what should be dark in tone. Deciding the actual color nearly always comes last. Since the shape of the room itself and the furniture arrangement make up the structure of the room, color is like the icing on a cake. I never begin with a color scheme, but a color plan.

"Finally, we come to the floor which is the foundation of the room. I insist that the floor be the same color as the wall, only darker to make a base. Now, the room moves from its dark floor shade up into the medium shade for walls and woodwork and curtains, and on to the light shade to help lift the beamed ceiling. The large sofa takes the same fabric as the curtains, whatever we decide. Large, immovable furniture should be quietly permanent. Chairs can be as brilliant as one wishes. The two upholstered chairs will have covers of patterned cloth. With walls and curtains the same color, paintings do not have to compete with them in color. An uncluttered background never results in monotony or dullness. It creates calmness and serenity and brings out the best in good furniture. I recommend a dark color scheme for bad furniture and a light scheme for good furniture. By dark I never mean dull; I mean brilliantly dark."

To live with color offers the satisfaction of colorful living. Ludwig Heydenreich, a German scientist, says, "Experiences, after all, are something to be evaluated, whereas experiments are conducted so that the results can be measured. In every scientific experiment our senses serve merely as controls, imperfect tools, while true experience is always based on the immediacy and fullness of our sensory perceptions." Now, he says something here that I think is very important to this conference. Thus, we in the art world have reached the second meeting point of art and science, where the two seem once more to enter a meaningful relationship, although on terms rather different from those met first in the sixteenth century.

Designers classify color as advancing and receding, warm and cool. The latter designation does not mean that colors actually change temperature, but indicates the psychological effect that colors have on the person and the appearance of the room or the space. The decorator's experience has taught him the value of the psychology of color to his clients. He has learned the value of color selection in creating this mood, the atmosphere and the degree of comfort required. He has learned to use color to camouflage architectural defects or mediocre furnishings the client wishes to use. If all related professionals or industries would accept the experience of others, and would find a way to use the same terminology, quicker progress could be made, but it will be necessary for each to have a working knowledge with the color system. We in AID are now working toward the end that in five years all schools and colleges that teach color to architecture, art, decoration and science students will teach it exactly the same way, and will teach the same system.

Open Forum Discussion

Moderator: Richard N. Jones, all Panel Members participating

Mr. Jones: I want to call on one of the most distinguished of all the past-presidents of the National Association of Home Builders, Alan Brockbank. Will you give us a few remarks on this question? Do you see in the Inter-Society Color Council program a valuable tool that the builders of America can put to work immediately to simplify the color problem?

Alan E. Brockbank, Community Construction Corporation: In the last two months I've spent almost all of my time traveling in various parts of the United States looking at projects that for various reasons were outstanding. I have found one thing indelibly marked on every successful project, and that is, there has been a very outstanding decorator involved in the planning and the showing of the houses. This is something that I have been impressed with in the past, but never as much as now.

The color consultants, the people who are really able to use color correctly, were never in such demand. I am very much pleased to have the opportunity to learn more about the identification of color through this conference. We use color in our own production of houses. We are in an area where we use brick, and you can have any color you want as long as it's red. However, we are rapidly changing, in my opinion, from the house of yesterday that was immovable, to a house that is going to be movable. I recently heard a prediction by a well-known authority that 10 years from now, bankers would be financing movable houses. If you have a location that you like, but don't like the house, you sell that house, have it moved away, and put up another one that you do like.

In a low-cost housing project opened at San Antonio a few weeks ago, the most outstanding house was a movable house. Most of us haven't seen the newest models of these mobile homes, but we should do so. It appears evident that within a very short time we are going to be building structures of all kinds and delivering them in two, three, or four sections. The whole house is movable in the case of the San Antonio model. This, again, suggests dissatisfaction on the part of people, and also suggests that maybe people would be much happier if they knew more about color.

I can assure you that the National Association of Home

Builders, and every other group that I happen to contact, the real estate boards, the lumber manufacturers, etc., are deeply interested in color. I hope that BRI and others will see fit to develop further some type of color system, and I hope that it becomes universal at an early date, before we go off on a tangent and can't rescue ourselves from some of the horrible colors that some of our customers sometimes want.

Dorothy Nickerson, U. S. Department of Agriculture: In this conference on the identification of colors for building, we can't solve all these problems and do all these things we've been talking about, unless you have a language for color. Even the dictionary has its problems with this. For instance, take the word, mauve. How do you describe it so that you convey something about it? The very thing we have been discussing is illustrated in the new Merriam-Webster Dictionary with a two-page spread of color plates that describe the situation exactly. The language must tell you what to do with something, where you put it, etc.

Milo D. Folley, Sargent, Webster, Crenshaw & Folley: How can we identify materials having variegated or blended color patterns, such as marble and asphalt tile?

Mrs. Bellamy: Each different area of color may be identified individually by Munsell notation and specified in relation to its particular area. Or, if the identification of the over-all color effect is desired, a Munsell notation can be obtained for the appearance of the surface when blended whether by rapid rotation (such as in disk spinning) or by use of a diffusing lense.

R. S. Thompson, Porcelain Enamel Institute: How closely do the ISCC-NBS painted color chips match each other from batch to batch?

Mr. Kelly: In the production of centroid colors, which I am working on right now, we are holding those to a very close tolerance. This is called the AAA tolerance by Munsell. It's about one NBS unit, a very small unit of color.

Mr. Folley: What is cost of NBS Bulletin 553? When is it to be available in its completed form? Will the color chips be included? What will that cost?

Mr. Kelly: The Dictionary of Color Names is available now from the Superintendent of Documents for $2.00 a copy. We are hoping to get the color-name charts ready in the early summer of 1963. They are to be sold separately from the Dictionary, probably at a cost somewhere around $2.00 or $3.00 per set. We are hoping that in a future reprinting of the Dictionary these will be incorporated in the Dictionary, so that it will be a self-sufficient volume. We are just about at the end of the third printing of the Dictionary.

W. R. Wyckoff, Fabco Division, Townsend Co.: Our major problem is economics, since we must match fasteners to various manufacturers' building products -- an expensive process involving acrylics and spectrophotometrics. Potentially, we would have to match thousands of hues. Do you have any suggestions for accomplishing this at low cost?

Mr. Call: Your first problem is to identify the color you are trying to match, and do that as easily and quickly as possible. The acceptance and use of the common color language we discussed provides this means of easy identification of color. This saves one cost of measuring each sample that you get. Because of the fact that many industries and products will be reported, their use of color will be reported, and you will be able to determine the use of color by the various products with which your fasteners are going to be used.

Unsigned Question: The effect of various types of illumination on color has been mentioned. Can someone discuss this phase in more detail?

Miss Miller: There are two problems in illumination of colors. First, we are dealing with two types of illuminants, incandescent and fluorescent. It is possible to maintain a color tolerance if you know which is going to be used. Unfortunately, if this is a commercial building, there are about 10 or 15 different tubes in the fluorescent family, all of different colors. When the maintenance man comes along, he often does not use the one that the colorist very carefully worked out in order to maintain the proper color. If you are using a deluxe warm white, he will frequently put in a cold white instead, so you are in constant trouble. The Federal Savings Bank in Detroit had worked out a very careful color plan, but they could not get the maintenance people to replace the tubes properly. Now, they have trained and put on their own maintenance crew.

The one thing particularly needed now is that more people know about the difference in lighting, and realize that artificial light and daylight react differently on colors. Also, in most cases, you do not need the same level of light at night that you do in the daytime. What you do need is attractive, comfortable, and harmonious lighting at night. Many of the people working on this problem have been trying to get the same tolerance by night lighting that they do by daylight, and they cannot do it. It is a matter of choosing the type of lighting you want to use and the placement of it, and also of achieving a level of light for daytime that is attractive and workable, plus attractive and a usable light by night.

This conference room for instance, will probably not be relighted for some time, yet there conceivably will be five different color schemes or plans used in this room. Architects could save their clients a great deal of money, in rooms of this kind, if in planning new decorating schemes they knew how much reflectance this lighting was going to give on every wall, and how much absorption. If the architect puts that on his blueprint, then anyone going to redecorate the room would know how to use the light properly. If he marks the reflectances and the absorption percentages for the given lighting system, it can be extremely helpful.

Appendix

Expression of Historical Usage

Interim Report of ISCC Subcommittee on Problem 23

1. HISTORY

At the 1957 Annual Meeting of the Inter-Society Color Council (ISCC), a delegate from the National Paint, Varnish and Lacquer Association (NPVLA), suggested (3) that there was a need for a standard technique of recording historical color usage of consumer products in order to facilitate inter-comparisons among industries. In June 1957, delegates from the National Paint, Varnish and Lacquer Association discussed with the ISCC Board of Directors the possibility of establishing an ISCC problem on this subject. After a meeting and discussion with representatives of other interested member bodies, and a recommendation of the Problems Committee Chairman, Problem 23 -- Expression of Historical Color Usage -- was formally established at the October 1957 meeting of the Board. The subcommittee was appointed, and studies were immediately and enthusiastically initiated.

The objective of this Subcommittee was "to develop a technique of expressing historical color usage of consumer products in order to facilitate intercomparisons among industries." This objective was elaborated as follows in the prospectus offering the ISCC sets of centroid colors to industry: "To derive compatible methods for recording historical consumer color preferences for products in individual industries, to publicize these methods and encourage all industries to adopt them so that (1) useful historical records of consumer preference trends of their products may be available within individual industries, and (2) the interrelationship of consumer color preference of one product upon the choice of another product may be established among industries."

This subcommittee held a number of meetings in New York, Philadelphia, and Washington and studied several proposed methods. The need for an appropriate set of color samples was

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soon found to limit progress, and several such sets were offered and studied. Since the ISCC-NBS (Inter-Society Color Council -- National Bureau of Standards) system of color names (13) had been developed to give a commonly understood name to each group of colors considered significantly different, the subcommittee decided that a set of colors representative of the centroids (11) of the ISCC-NBS color-name blocks could be a logical starting point.

The ISCC Board of Directors reactivated the Subcommittee on Problem 2 -- Color-Names -- in November 1958 for the purpose of producing a set of colored samples representing the centroids of the ISCC-NBS color-name blocks, hereinafter called the ISCC-NBS centroid colors. The fact that the boundaries of the ISCC-NBS color-name blocks were completely specified in terms of the Munsell system (and therefore, by extension, in terms of any recognized and specified system) weighed heavily in this decision. Methods for handling statistical color usage data based on this system were developed in a program paralleling the production of the colored samples. The 1959 NPVLA Annual Paint Color Survey (18) (reporting color usage during 1958) was prepared utilizing these techniques, including use of the ISCC-NBS color-name blocks, which were found well suited for expression of color usage in the paint industry. Whether these blocks will be suited to all industries is to be determined by further committee study.

The Munsell color system (2, 16, 17) was used in the NPVLA Color Survey for the fine designations, due to its simplicity and its use in the ISCC-NBS system. However, the Color Harmony Manual (5, 6, 8, 25 -- Ostwald system) or any other color designation system which has a sufficient number of colored samples to satisfy the demands of the user, can be used for such a purpose. Any recognized color system is translatable into the ISCC-NBS system of color-name blocks (13).

2. COLLECTION AND ORGANIZATION OF SAMPLES

A company desirous of studying its sales by color would prepare a report for each product which would contain the percentage of total sales represented by each color used for that product. This would necessitate the collection of typical samples of that product for classification and color measurement. These samples might be segregated into groups, not only according to color but also according to any other importantly different characteristics, as in the 1959 NPVLA Report which gives a breakdown under the headings: all-purpose enamels, latex paints, exterior paints and interior flats, the samples in each group to be ordered according to color, and each marked with its percentage-of-sales figure.

Data sheets such as those in Appendix A are designed for use in collecting such information. The details are requested to supply pertinent information that will permit future studies of color trends by product, color, industry, location, etc. Each sheet should be completed to provide for future statistical evaluations of a particular product.

3. DETERMINATION OF COLOR DESIGNATION

There are a number of methods for determining the designation of a color, each differing in the degree of precision of specification. A choice of five levels of precision is suggested by the committee, varying from the more precise to one so general that it provides for a total of only 13 color groups. The most accurate and precise method (a) is determined from instrumental measurement and numerical specification of the color in terms of C.I.E. (x,y,Y) or Munsell H V/C carried to suitable decimal limits. The next most accurate specification (b) is in terms of the notations of the nearest matching color chips of such systems of color samples as the Munsell and Ostwald collections, each having well over 1,000 samples. The next finest of the five levels (c) used in this method is a fractionation of psychological color space into a limited number of blocks such as is represented by the 267 blocks in the ISCC-NBS system of color names. The adequacy of this fractionation in meeting the objectives of the committee is in some question, and several members of this sub-committee are now engaged in testing whether some revision of the ISCC-NBS system may not be better suited to certain industries.

In the meantime, the subcommittee recommends use of the ISCC-NBS system. Tentatively recommended is the next more general grouping (d), which consists of 26 ISCC-NBS hue names, plus white, gray and black, and finally the most general grouping (e), which consists of the 10 principal ISCC-NBS hue names, plus white, gray and black. Each level of precision of specification of the color (a,b,c,d), may be converted easily into the next more general level; that is, specification by method (a) can be converted to (b); (b) to (c), and so on.

> (a) The designation of a color may be determined most accurately by measurement of the color by a spectrophotometer, with integration to obtain colorimetric specifications. Tristimulus colorimetry, with appropriate safeguards, can also be used to obtain an equivalent specification. The numerical results of these measurements are in terms of tristimulus values X, Y, and Z, or in chromaticity coordinates x,y, and Y, daylight reflectance (9). These may be translated into Munsell notations by use of conversion charts contained in the Final Report of the O.S.A. Subcommittee on the Spacing of the Munsell Colors (19), by use of published tables (7, 12, 21), or by the use of automatic data processing machines suitably programmed (10, 23, 24). This method is in accord with the American Standards Association's method for measuring and specifying color, Z58.7.1-3-1951 (1).

(b) The Munsell notation of a color may be determined to a good approximation by comparing it visually with the color samples in the Munsell Book of Color (see ASTM Method D 1535-58T for specifying color by the Munsell System (2)). The Munsell notation may also be determined from the Ostwald notation of the Color Harmony Manual (CHM) by converting the CHM notation into a Munsell notation by tables (4). The same procedure may be followed if the notation of the color has been determined by use of the first edition of the Maerz and Paul Dictionary of Color (14, 20) or by the Plochere Color System (15, 22).

(c) If the ISCC-NBS color-name method of reporting is to be used, it can be done by first obtaining the Munsell notation for a color and converting it to the ISCC-NBS designation by use of the tables in NBS Circular 553. By use of the centroid samples, the ISCC-NBS name for a color may be obtained more quickly and easily by comparing it directly with the ISCC-NBS centroid samples and determining which of these is closest to the color of the particular sample. The color steps are fewer than those provided by the Munsell notation, but they may be sufficiently close for many industrial purposes. If the color is about equally different from two centroids, the centroid whose name is most descriptive of the color of the sample should be used. These figures, the ISCC-NBS color-name block number, and the percentage-of-sales figure, may be entered directly on the data reporting sheets.

4. STATISTICAL TREATMENT

The ultimate value of this program to a manufacturer is the knowledge of the relative sales of different colors in any product for specific periods of time. Color usage may be graphed on the 13-color level (e) as was done in the NPVLA Report. Admittedly, the identification of small or precise color ranges in such a plot is not possible, due to the wide range of samples statistically incorporated into each group. For closer color identification, the number of groups used in the report should be larger. The next level (d) which is proposed contains 29 groups. This number is too large to graph, so such data would be presented in tabular form.

For greater precision in identifying specific colors and for providing information regarding changes in certain small color ranges, the level (c) represented by the 267 ISCC-NBS centroid colors, or by possible revisions thereof, would be used for tabulation. If the fineness of this level of specification is not sufficient, and information regarding changes in smaller color ranges is desired, Munsell notations (b) in whole numbers should suffice. Greater precision can be obtained by using Munsell notations to one or two decimals, or from the use of chromaticity coordinates and daylight reflectance determined by an instrument (method a), but only in exceptional cases will such precision be required for use in reporting color usage.

An appropriate fractionation of color space, such as the ISCC-NBS system, is ideal for statistical treatment of data recorded by methods a,b,c,d, and e. To be useful, it should be possible to convert tristimulus values or chromaticity coordinates into an appropriate designation by simple graphical or machine methods. Then Munsell notations, for example, can be converted into ISCC-NBS color designations by the color-name charts in NBS Circular 553. The subsequent three steps in the roll-up technique are described in Section 5, and in Appendixes B and C.

Appendixes B and C give the groupings at two levels (c and d) of the roll-up technique. Appendix B lists the ISCC-NBS color-name blocks which are combined into the 29 larger groups represented by the 26 hue names and white, gray, and black (method d). Appendix C lists the 10 main hue names and white, gray and black, which comprise the 13 larger principal color-name groupings (method e). The principal colors are pink, red, orange, brown, yellow, olive, yellow green, green, blue, purple, white, gray, and black. Thus, data recorded to any fineness (a,b,c,d,e) of color designation can be statistically combined.

This method does not provide a measure of amounts of color used, but it does present a measure of public acceptance of the colors of products offered. Hence, the principal requirement is that the sum of all percentage figures in each grouping must total 100%. For example, the sum of the percentage of sales of the nine colors of a company's product must total 100%. If this report is combined by addition with another report with its percentage-of-sales figures of seven colors, the total of the percentage-of-sales figures would equal 200%. Therefore, at each level and at every combination of data, percentage-of-sales figures must be averaged instead of added. In this way the total will always be 100%, and the proportionality of each item to the whole is not changed. This is the system used in the NPVLA Annual Report, and is on the basis of dollar-value of sales. The same method may be used with any other significant index, such as gallons, or square feet.

5. AN EXAMPLE

Appendix D is an example of how Company A would report its usage of color by method (b). Part I (b to c) shows only a portion, the Pinks, of the detailed report. Here the usage of color is reported by Munsell notations (as stated above, the Color Harmony Manual or any other color designation system which has a sufficient number of colored samples to satisfy the demands of the user, can be used) which are grouped under the proper ISCC-NBS color-name blocks. This is a characteristic step in the roll-up technique; data recorded by method (b) may be rolled up to be recorded in terms of method (c). Note that the sum of the individual percentage-of-use figures of each individual Munsell notation (method b) is given for that particular ISCC-NBS color-name block (method c). The same procedure is followed for each color-name block. The color-name charts in NBS Circular 553 are used for this purpose.

The next step in the roll-up technique is illustrated in Part II (c to d). Here the individual color-name blocks of method c are grouped together according to the 29 name blocks of method d, by use of the lists in Appendix B under the different hue names, such as purplish pink (pPk), Pink (Pk), and yellowish pink (yPk). The sum of the individual color-name-block totals is assigned to the color-name group.

Part III illustrates the use of the roll-up technique in combining the 29 groups of method d into the 13 main name groups of method e, as illustrated in Appendix C. Again, the totals assigned to the 29 groups of method d, are added and assigned to the 13 main groupings of method e. Part IV consists of a table showing the percentage of color usage in each of 13 main color name groupings, as obtained by use of the roll-up technique described.

Now, if Company B reported its usage of color on the 13 color-name level (e) it would be possible to combine its results with those of Company A. Appendix E shows in the first three columns of Part I, the data from Part III of Appendix D. The data from Company B are entered in column 4. The sum of each is equal to 100%. When the totals for A and B are summed in column 5, the total is 200%. When the totals are divided by the number of sets of data that are combined, the average is still 100% and the relative proportion of one item to another item, or to the whole, is not changed. The same technique would be used if the color data to be combined were given in terms of the Munsell notation (method b) or in terms of chromaticity coordinates (method a). If several sets of data are combined to get the average, the totals would be divided by the number of sets used.

Part II of Appendix E consists of a table showing the final results obtained by use of the roll-up technique for the combined or average color usage data for Companies A and B, in terms of the 13 name groupings of method e.

6. THE INDUSTRY OR COMPANY REPORT

An industry or company report should conform to the guideposts laid out above, the actual form of the report to be governed by its use. It may illustrate one or more of the five levels (a,b,c, d,e) of fineness of color specification, depending upon the need.

Use of a method such as the one described here permits an individual company to compare color experiences and trends within and between industries and products. Hence, while individual companies may adopt their own designations for color standards--even report on them by these designations on an industry basis--it is important that these standards be specified in such a way that the data can be fitted into one or another of the levels (a to e) of the above method in order that comparisons may be made with colors used for other products and in other industries.

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APPENDIX A, PART I

ISCC COLOR TREND SURVEY
ECONOMIC DATA SHEET

DATE ____________________

FOR PERIOD ____________________

INDUSTRY ____________________ PRODUCT ____________________

NAME OF COMPANY ____

ADDRESS ____

____

REPORTING OFFICER ____________________ TITLE ____________________

TYPE OF BUSINESS: MFG. ____ WHOLESALE ____ RETAIL CHAIN ____

RETAIL IND. ______ DISTRIBUTOR ______ MAIL ORDER ________

RAW MATERIAL PRODUCER ____________ OTHER ____________

LOCATION OF MFG. OR RETAIL SALE: CITY ____________________

STATE ____________________

RELATIVE VALUE OF PRODUCT: HIGH ____ MEDIUM ____ LOW ______

FINISH: GLOSSY ______ SEMI-GLOSSY ______ TRANSPARENT ______

MAT ______ TRANSLUCENT ______ OPAQUE ______ OTHER ______

NUMBER OF COLORS USED ON THIS PRODUCT: ONE _____ TWO ______

THREE ______ MULTI __________

APPENDIX A, PART II

ISCC COLOR TREND SURVEY
COLORIMETRIC DATA SHEET

REPORT FOR PERIOD ____________ DATE OF REPORT ____________

NAME OF COMPANY ____

INDUSTRY ____________________ PRODUCT ____________________

Notation Munsell	Number of ISCC-NBS Color-Name Block	% of Total Sales of this Product Represented by Each Color

APPENDIX B

Number and Abbreviation of the ISCC-NBS Color-Name Blocks Comprising Each of 29 Color-Name Groups (Method d)

1. PINK -- 1.v, 2.s, 3.deep, 4.l, 5.m, 6.d, 7.p, 8.gy.
2. RED -- 11.v, 12. s, 13. deep, 14.v. deep, 15.m, 16.d, 17.v.d., 18.l.gy, 19.gy, 20.d.gy, 21.blackish.
3. YELLOWISH PINK -- 25.v, 26.s, 27.deep, 28.l, 29.m, 30.d, 31.p, 32.gy, 33.brPk.
4. REDDISH ORANGE -- 34.v, 35.s, 36.deep, 37.m, 38.d, 39.gy.
5. REDDISH BROWN -- 40.s, 41.deep, 42.l, 43.m, 44.d, 45.l.gy, 46.gy, 47.d.gy.
6. ORANGE -- 48.v, 49.brill, 50.s, 51.deep, 52.l, 53.m, 54.brownish.
7. BROWN -- 55.s, 56.deep, 57.l, 58.m, 59.d, 60.l.gy, 61.gy, 62.d.gy.
8. ORANGE YELLOW -- 66.v, 67.brill, 68.s, 69.deep, 70.l, 71.m, 72.d, 73.p.
9. YELLOWISH BROWN -- 74.s, 75.deep, 76.l, 77.m, 78.d, 79.l.gy, 80.gy, 81.d.gy.
10. YELLOW -- 82.v, 83.brill, 84.s, 85.deep, 86.l, 87.m, 88.d, 89.p, 90.gy, 91.d.gy.
11. OLIVE BROWN -- 94.l, 95.m, 96.d.
12. GREENISH YELLOW -- 97.v, 98.brill, 99.s, 100.deep, 101.l, 102.m, 103.d, 104.p, 105.gy.
13. OLIVE -- 106.l, 107.m, 108.d, 109.l.gy, 110.gy, 111.d.gy.
14. YELLOW GREEN -- 115.v, 116.brill, 117.s, 118.deep, 119.l, 120.m, 121.p, 122.gy.
15. OLIVE GREEN -- 123.s, 124.deep, 125.m, 126.d, 127.gy, 128.d.gy.
16. YELLOWISH GREEN -- 129.v, 130.brill, 131.s, 132.deep, 133.v.deep, 134.v.l, 135.l, 136.m, 137.d, 138.v.d.
17. GREEN -- 139.v, 140.brill, 141.s, 142.deep, 143.v.l, 144.l, 145.m, 146.d, 147.v.d, 148.v.p, 149.p, 150.gy, 151.d.gy, 152.blackish.
18. BLUISH GREEN -- 158.v, 159.brill, 160.s, 161.deep, 162.v.l, 163.l, 164.m, 165.d, 166.v.d.
19. GREENISH BLUE -- 167.v, 168.brill, 169.s, 170.deep, 171.v.l, 172.l, 173.m, 174.d, 175.v.d.
20. BLUE -- 176.v., 177.brill, 178.s, 179.deep, 180.v.l, 181.l, 182.m, 183.d, 184.v.p, 185.p, 186.gy, 187.d.gy, 188.blackish.
21. PURPLISH BLUE -- 194.v, 195.brill, 196.s, 197.deep, 198.v.l, 199.l, 200.m, 201.d, 202.v.p, 203.p, 204.gy.
22. VIOLET -- 205.v, 206.brill, 207.s, 208.deep, 209.v.l, 210.l, 211.m, 212.d, 213.v.p, 214.p, 215.gy.
23. PURPLE -- 216.v, 217. brill, 218.s, 219.deep, 220.v.deep, 221.v.l, 222.l, 223.m, 224.d, 225.v.d, 226.v.p, 227.p, 228.gy. 229.d.gy, 230.blackish.
24. REDDISH PURPLE -- 236.v, 237.s, 238.deep, 239.v.deep, 240.l, 241.m, 242.d, 243.v.d, 244.p, 245.gy.
25. PURPLISH PINK -- 246.brill, 247.s, 248.deep, 249.l, 250.m, 251.d, 252.p, 253.gy.
26. PURPLISH RED -- 254.v, 255.s, 256.deep, 257.v.deep, 258.m, 259.d, 260.v.d, 261.l.gy, 262.gy.
27. WHITE -- 263.white, 9.pk, 92.y, 153.g, 189.b, 231.p.
28. GRAY -- 264.light gray, 10.pk, 93.y, 154.l.g, 190.l.b, 232.l.p, 265.medium gray, 22.r, 63.l.br, 112.l.Ol, 155.g, 191.b, 233.p, 266.dark gray, 23.d.r, 64.br, 113.Ol, 156.d.g, 192.d.b, 234.d.p.
29. BLACK -- 267.black, 24.r, 65.br, 114.Ol, 157.g, 193.b, 235.p.

APPENDIX C

29 Name Groups (Method d) Combined into 13 Main Name Groups (Method e)

1. PINK -- Purplish Pink, Pink, Yellowish Pink,
2. RED -- Purplish Red, Red,
3. ORANGE -- Reddish Orange, Orange,
4. BROWN -- Reddish Brown, Brown, Yellowish Brown,
5. YELLOW -- Orange Yellow, Yellow, Greenish Yellow,
6. OLIVE -- Olive Brown, Olive, Olive Green,
7. YELLOW GREEN -- Yellow Green,
8. GREEN -- Yellowish Green, Green, Bluish Green,
9. BLUE -- Greenish Blue, Blue, Purplish Blue,
10. PURPLE -- Violet, Purple, Reddish Purple,
11. WHITE -- White,
12. GRAY -- Gray,
13. BLACK -- Black.

APPENDIX D, PART I (b to c)

ISCC-NBS Color Designation, Number & Munsell Notations	Percent of Total Sold
Brilliant Purplish Pink (246)	.02
3RP 8/10	.02
Strong Purplish Pink (247)	.14
6RP 7/10	.06
9RP 7/13	.08
Deep Purplish Pink (248)	.07
4RP 6/11	.07
Light Purplish Pink (249)	.11
9P 8/6	.11
Moderate Purplish Pink (250)	.22
4RP 7/6	.06
9RP 7/8	.16
Dark Purplish Pink (251)	.04
6RP 6/8	.04
Pale Purplish Pink (252)	.15
10P 8/3	.04
10P 9/4	.03
6RP 9/4	.08

ISCC-NBS Color Designation, Number, & Munsell Notations	Percent of Total Sold
Light Pink (4)	.81
4R 9/4	.25
6R 9/6	.56
Moderate Pink (5)	1.22
1R 7/3	.62
2R 7/4	.43
6R 8/6	.17
Dark Pink (6)	1.61
1R 6/6	.23
5R 6/6	1.38
Pale Pink (7)	.08
3R 9/2	.03
3R 9/3	.05
Grayish Pink (8)	.08
2R 7/2	.02
2R 8/3	.06
Vivid Yellowish Pink (25)	.24
7R 7/12	.24

(Continued on next page)

APPENDIX D, PART I (b to c) -- (CONTINUED)

ISCC-NBS Color Designation, Number & Munsell Notations	Percent of Total Sold
Grayish Purplish Pink (253)	.27
10P 7/2	.06
10P 7/4	.11
6RP 7/4	.10
Vivid Pink (1)	.09
2R 7/12	.09
Strong Pink (2)	.03
4R 7/9	.03
Deep Pink (3)	.92
2R 6/8	.13
2R 6/10	.21
4R 6/12	.31
5R 6/9	.27
Pale Yellowish Pink (31)	.13
3YR 9/2	.13
Grayish Yellowish Pink (32)	.16
7R 7/2	.08
7R 8/2	.05
8R 8/2	.03
Brownish Pink (33)	.15
6YR 7/2	.15

ISCC-NBS Color Designation, Number, & Munsell Notations	Percent of Total Sold
Strong Yellowish Pink (26)	.37
6R 7/8	.37
Deep Yellowish Pink (27)	.29
7R 6/8	.17
7R 6/12	.12
Light Yellowish Pink (28)	.14
8R 9/6	.14
Moderate Yellowish Pink (29)	.57
6R 7/4	.23
6R 7/6	.34
Dark Yellowish Pink (30)	.26
6R 6/6	.26

APPENDIX D, PART II (c to d)

ISCC-NBS Hue Name & Color Designation	Percent of Total Sold
Purplish Pink	1.02
brill pPk	.02
s pPk	.14
deep pPk	.07
l pPk	.11
m pPk	.22
d pPk	.04
p pPk	.15
gy pPk	.27
Pink	4.84
v Pk	.09
s Pk	.03
deep Pk	.92
l Pk	.81
m Pk	1.22
d Pk	1.61
p Pk	.08
gy Pk	.08

Yellowish Pink	2.31
v yPk	.24
s yPk	.37
deep yPk	.29
l yPk	.14
m yPk	.57
d yPk	.26
p yPk	.13
gy yPk	.16
br Pk	.15

APPENDIX D, PART III (d to e)

Color Designation, 29 Groups	Percent of Total Sold	
	(d)	(e)
Pink		8.17
Purplish Pink	1.02	
Pink	4.84	
Yellowish Pink	2.31	
Red		4.11
Purplish Red	1.01	
Red	3.10	
Orange		1.14
Reddish Orange	.87	
Orange	.27	
Brown		1.92
Reddish Brown	.52	
Brown	.89	
Yellowish Brown	.51	
Yellow		18.14
Orange Yellow	3.01	
Yellow	8.16	
Greenish Yellow	6.97	
Olive		8.02
Olive Brown	1.63	
Olive	3.58	
Olive Green	2.81	

Color Designation, 29 Groups	Percent of Total Sold	
	(d)	(e)
Yellow Green		2.16
Green		16.04
Yellowish Green	5.69	
Green	3.91	
Bluish Green	6.44	
Blue		8.12
Greenish Blue	2.41	
Blue	4.07	
Purplish Blue	1.64	
Purple		1.26
Violet	.54	
Purple	.17	
Reddish Purple	.55	
White		19.86
Gray		1.54
Black		9.52
Total		100.00

APPENDIX D, PART IV (e)

Color Designation, 13 Groups	Percent of Total Sold
Pink	8.17
Red	4.11
Orange	1.14
Brown	1.92
Yellow	18.14
Olive	8.02
Yellow green	2.16
Green	16.04
Blue	8.12
Purple	1.26
White	19.86
Gray	1.54
Black	9.52
Total	100.00

APPENDIX E, PART I (d to e)

ISCC-NBS Color Designation	Color Usage as Reported by 29 Color-Name Groups		Color Usage as Reported by 13 Color-Name Groups	Total	Average = Total Divided by 2
	Company A		Company B		
	(d)	(e)	(e)		
Pink		8.17	7.11	15.28	7.64
Purplish Pink	1.02			1.02	.51
Pink	4.84			4.84	2.42
Yellowish Pink	2.31			2.31	1.15
Red		4.11	4.23	8.34	4.17
Purplish Red	1.01			1.01	.50
Red	3.10			3.10	1.55
Orange		1.14	.98	2.12	1.06
Reddish Orange	.87			.87	.43
Orange	.27			.27	.14
Brown		1.92	1.36	3.28	1.64
Reddish Brown	.52			.52	.26
Brown	.89			.89	.44
Yellowish Brown	.51			.51	.26
Yellow		18.14	14.94	33.08	16.54
Orange Yellow	3.01			3.01	1.50
Yellow	8.16			8.16	4.08
Greenish Yellow	6.97			6.97	3.49
Olive		8.02	9.16	17.18	8.59
Olive Brown	1.63			1.63	.81
Olive	3.58			3.58	1.79
Olive Green	2.81			2.81	1.41
Yellow Green		2.16	4.06	6.22	3.11
Green		16.04	20.82	36.86	18.43
Yellowish Green	5.69			5.69	2.84
Green	3.91			3.91	1.96
Bluish Green	6.44			6.44	3.22
Blue		8.12	7.98	16.10	8.05
Greenish Blue	2.41			2.41	1.20
Blue	4.07			4.07	2.04
Purplish Blue	1.64			1.64	.82
Purple		1.26	1.98	3.24	1.62
Violet	.54			.54	.27
Purple	.17			.17	.08
Reddish Purple	.55			.55	.28
White		19.86	16.22	36.08	18.04
Gray		1.54	4.38	5.92	2.96
Black		9.52	6.78	16.30	8.15
Total		100.00	100.00	200.00	100.00

APPENDIX E, PART II (e)

Color Designation, 13 Groupings	Percent of Total Sold
Pink	7.64
Red	4.17
Orange	1.06
Brown	1.64
Yellow	16.54
Olive	8.59
Yellow Green	3.11
Green	18.43
Blue	8.02
Purple	1.62
White	18.04
Gray	2.96
Black	8.15
Total	100.00

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Requirements for Weatherproofing Thin Shell Concrete Roofs, No. 972, 1962, 47 p., $5.00

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